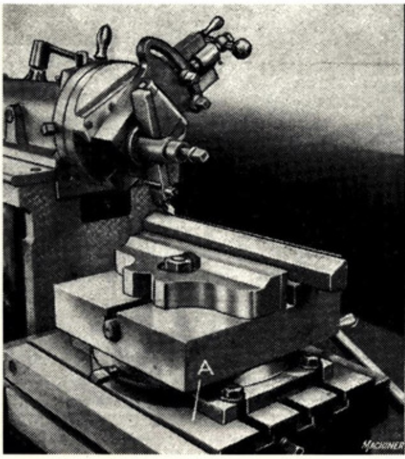
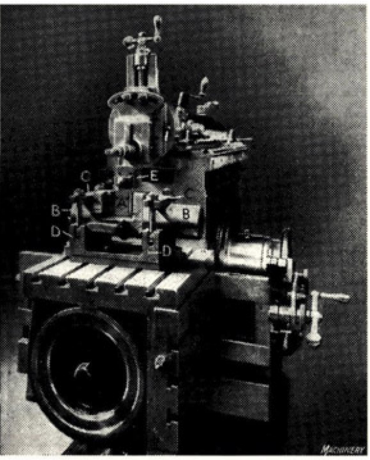
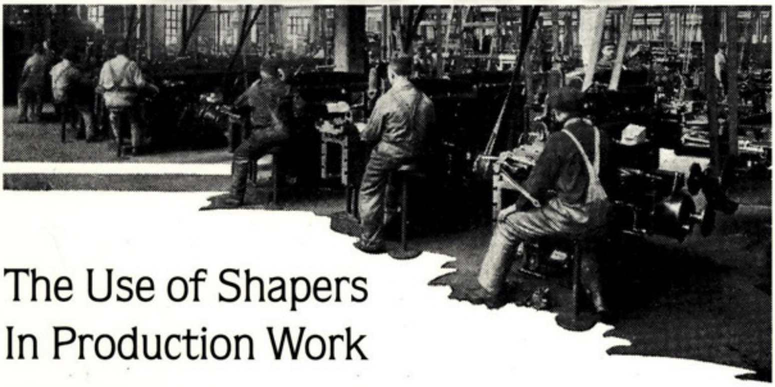




PRODUCTION SHAPING



The Use of Shapers In Production Work

Machinery's Industrial Secrets

Selected articles from early issues of Machinery Magazine revealing secrets of manufacturing.

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Production Shaping

The Use of Shapers in Production Work for Planing Column and Table Castings for Drilling Machines

MACHINERY - NOVEMBER 24, 1921

Shapers are extensively used in tool rooms for such work as the forming of die blocks. By employing the various combinations of feed movements provided on machines of this type, pieces of intricate form can be machined, hence the name "shaper." It is a general impression that the profitable use of these machines is restricted to tool and experimental work and similar operations, but although shapers are not extensively used on production work, there are many shops which have found them efficient for the performance of short planing and other similar operations on a production basis. For work that comes within their range they have several advantages. Among these may be mentioned a low initial investment, small maintenance cost, small amount of floor space required, and simplicity of operation, enabling them to be attended by low-priced labour.

The majority of the production jobs which are satisfactorily done on the shaper are those where the nature of the work is such that it is impracticable to take advantage of the increased efficiency resulting from the stringing up of a number of pieces of work on the table of a planer. It will be evident, then, that in cases where a choice must be made between setting up single piece of work on a planer or on a shaper, the lower item of overhead that must be charged against the latter type of machine is usually of sufficient importance to represent a determining factor, provided the production time is not unreasonably high.

A certain firm of drilling machine manufacturers uses shapers for five different manufacturing operations on the top column, the lower column, and the table drilling machines, and as the dimensions of these parts vary considerably for different sizes of machines, it is necessary to have a number of shaper fixtures available.

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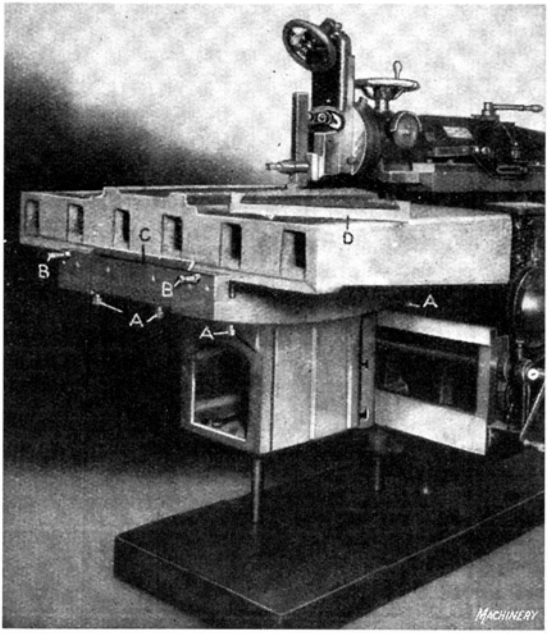


Fig. 1. A 32-inch Shaper equipped for planing the Table Bearing on Columns of Multiple-spindle Drilling Machines

Before starting upon a detailed description of the operations performed on these shapers, it may be well to make a general statement concerning the nature of the shaper work that is done. Although planers are used in this particular plant there are certain castings, such as those for the table and the lower column for multiple-spindle machines, which are too wide to pass between the housings of any planer in this shop. Consequently, the machining of these castings presented the alternative of either purchasing a larger sized planer or of devising some other means of handling the work.

As there were only a moderate number of these pieces to be planed, the management felt that the investment in a planer of sufficient capacity for this work would not be warranted. A study of this problem made it apparent, that, as the length of the surfaces to be planed on even the largest castings was quite short, a shaper with a 32-inch stroke would have sufficient capacity to handle the work, provided it was equipped with a fixture that would support the casting rigidly under the shaper ram. Such a machine could be purchased at a lower first cost, and it would possess the further advantage of occupying less floor space.

The other type of planing operation for which shapers are used in this plant is the machining of surfaces on castings that have a shoulder at the end of the finished surface, which makes it impracticable to set them up in a row on a planer table. For jobs of this kind the shaper is often found a more desirable tool than the planer because of the absolute control of the stroke, and as previously stated, when only one piece of work can be machined at one time, the smaller amount of floor space taken by the shaper is also an advantage.

Planing Dovetailed Bearing on Drilling-machine Column

Fig. 1 illustrates a 32-inch shaper, which is used for planing the dovetailed table bearing on the lower column of a six spindle drilling machine, this being the first operation performed on the casting. This dovetailed bearing is used as the locating point for the performance of subsequent operations. Naturally it must be located in approximately a central position on the casting, and planed in accurate alignment with the side walls. To ensure obtaining these results, a preliminary setting is made by first measuring from the two extreme outer edges to locate the centre line of the casting, and then setting the tools in the position to plane the dovetailed bearing central with this line.

After this preliminary location has been accomplished, the casting is levelled up by means of five screws, four of which are shown at *A*. At the rear, the casting rests against two horizontal screws which may be adjusted to square it up with the line of travel of the shaper ram. The final clamping is accomplished by means of two screws *B*, which are tightened against the casting and secured by means of lock nuts. The tools are set for planing the dovetail by means of a gauge *C*, and after the operation has been completed, the accuracy of the finished work is tested with a gauge *D*.

In planing this dovetailed bearing, one roughing and one finishing cut are employed. Round-nosed roughing tools are used on the horizontal surfaces, while special rough-dovetailing tools are used on the angular faces. For taking the finishing cuts, the horizontal surfaces are machined with a square-nosed tool, while special finish-dovetailing tools are used on the angular faces. The fixture shown in Fig. 1 is also adapted for use in planing the lower columns of drilling machines with either four or six spindles. It will be seen that this fixture is set up on the regular table of the shaper.

Planing Dovetailed Column Bearing in Drilling Machine Table

Fig. 2 shows a 32-inch shaper equipped with a special extension at the front of the base to adapt it for the use of a fixture for holding the tables of four-spindle drilling machines while the dovetailed column bearing is being planed. As the castings come to this machine, a planing operation has been performed on the working surface of the table, which is at the back in the illustration, and the lower edge *A* of the casting has also been planed. These surfaces are utilized as locating points for setting up the work on the shaper. The operation consists of planing a dovetailed bearing at one side and a square seat for a dovetailed gib at the other side of the table bearing on the column. This bearing must be centrally located, and with that object in view, the casting is centred in the fixture by measuring from the two ends of the planed working surface of the table.

The casting rests in the fixture on blocks *B* that support the planed edge *A*, and by using blocks of different heights the same fixture may be employed for planing tables for different sized drilling machines. It will be apparent from the illustration that this work-holding fixture is of the so-called box form, and that the casting is slid in from one end and lowered into place on the supporting blocks *B*. This fixture is hung on the saddle by bolts in the T-slots, and takes the place of the regular table of the machine. When ordering a machine for handling this work, a special extension base *C* was specified, so that a support could be used at the front of the fixture to carry its weight, which is quite considerable. The work is clamped back in the fixture against a finished face that is arranged to come in contact with the previously planed working surface of the drilling machine table.

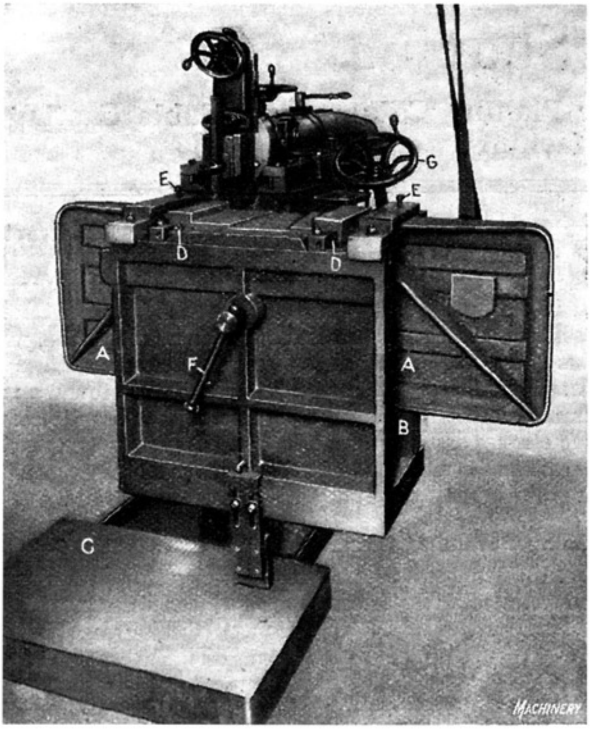


Fig. 2. A 32-inch Shaper equipped for planing the Column Bearing in Tables of Multiple-spindle Drilling Machines

After adjusting the position of the casting so that it is properly centred, a preliminary clamping is accomplished by means of two screws *D* that force the casting back against the locating face at the rear of the fixture. Two screws *E* are next tightened to hold the casting down, and a screw inside the fixture is then raised under the centre of the part to be planed, in order to support the thrust of the cut. Finally, the main clamping screw *F* is tightened, this screw being relied upon to accomplish the major part of the clamping action. In order to place control of adjustments of the saddle on the shaper crossrail within easy reach of the operator while at the front of the work-holding fixture, a special set of gearing, manipulated by a hand wheel *G*, has been placed on the machine.

In planing the surfaces of the table bearing on the column, one roughing and one finishing cut are required. For the horizontal surfaces at the bottom of the bearing a round-nosed roughing tool is employed, while a square-nosed tool is utilized for running down the vertical side of the bearing, and a special rough-dovetailing tool is used for taking the first cut on the inclined side. For the finishing cuts, a square-nosed tool is used on the horizontal surfaces and for running down the side of the vertical surface, while a finish-dovetailing tool is utilized on the inclined side. The recess between the finished horizontal surfaces of the bearing is roughed out with a round-nosed tool, and no finishing cut is taken. The dovetailed bearing planed on this shaper is 12 inches long by 18 3/8 inches wide by 1 1/4 inches deep. The material is cast iron, and the time required for the job is about two hours.

Planing Top Columns for Drilling Machines

There are three planing operations to be performed on the top column. Two of the surfaces to be machined are located in such a way that there is not sufficient clearance for a tool to pass over a string of castings when set up on the table of a planer. Consequently, the necessity of handling one casting at a time makes it a more economical proposition to perform this work on a shaper, for reasons that have already been mentioned. The third surface to be planed on these parts is the relatively small bottom face, where the top column is connected to the lower column member; and the fixture for holding the work for this operation is so designed that three castings may be set up at a time. In this way the shaper is able to give a very satisfactory rate of production, and the output from a single machine is adequate to fulfil the requirements of the production schedule on this class of work.

Method of Setting-up Top-column Castings for the First Operation

The first operation on these castings consists of planing the dovetail for the drilling head, and as this bearing is not only an important factor in governing the efficiency of operation of the drilling machine, but is also used as the locating point in setting up the work for all subsequent operations, it will be evident that great care must be taken in setting up the work, and in planing this important bearing surface. Referring to Fig. 3, which shows a 24-inch shaper equipped for the first operation, it will be seen that the work is held in a box type of fixture that is bolted to the saddle T-slots in place of the regular shaper table.

Inside the box fixture there are two adjusting screws on which the casting rests, and they may be manipulated to provide for levelling the work so that the dovetailed bearing will be planed in proper relation to other fixed points. At the end nearest to the machine, there is provision for using a clamping bolt and strap (not shown) to hold the casting down, and at the opposite end of the fixture there will be seen a cross bar and screw *A* for supporting the end thrust of the tool. Sidewise location and clamping of the casting in the fixture is accomplished by five bolts *B* at each side, which are tightened against the casting to locate and hold it in the desired position for planing.

Aligning Casting with Line of Travel of the Shaper Ram

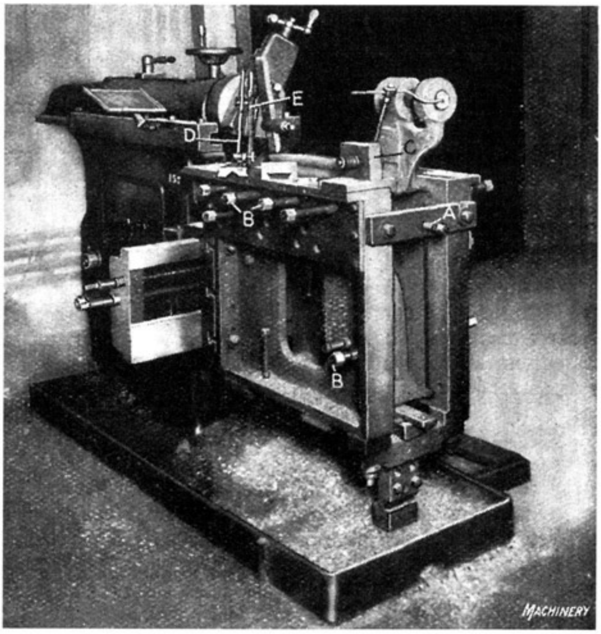
Attention has been directed to the importance of lining the casting up accurately before starting the planing operation. The methods by which this result is accomplished are as follows. First, it is necessary to so locate the work that a line from the centre of the spindle bearing hole to the centre of the base of the column is parallel to the line of travel of the shaper ram. For obtaining this alignment, use is made of a special gauge *C* that is carried on a base having a shoulder that fits over the inner edge of one of the top rails on the work-holding fixture, which is accurately finished for this purpose. A wooden plug is placed in the spindle bearing hole and rubbed with chalk so that the centre of this hole can be marked, with reference to both the centre of the opening and the outside of the boss.

Similarly, a chalk mark is placed on the top of the casting at the opposite end, so that a central line can be scribed in this chalk. After the fixture has been set up with the finished edge of the top rail in alignment with the line of travel of the shaper ram, gauge *C* is used, as shown in Fig. 3, to compare the position of the scribed centre of the spindle bearing opening with the centre line scribed on the base of the column. The arm on which the measuring bar of gauge *C* is carried is mounted on a pivot so that it may be swung against the tension of a coiled spring. In this way it is an easy matter to first reach the spindle opening, and then move the gauge to the opposite end of the casting, and swing the measuring bar down into engagement with the work. This tool affords a convenient means of measuring the distance from the edge of the top rail of the fixture to the two scribed lines. If the work has been properly aligned for planing, these two distances should be equal.

Adjusting the Horizontal Position of the Work

The next step in setting up

Fig. 3. A 24-inch Shaper equipped for planing the Drilling Head Bearing on Columns of Single-spindle Drilling Machines



the work is to bring the casting into a horizontal position, that is, to have it so located that as the casting lies in the work-holding fixture, the centre of the spindle bearing hole will be at exactly the specified distance above the top surface of the opposite end of the casting, namely, 7 1/8 inches for the size machine referred to. The test for this setting is accomplished by means of a surface gauge and a special gauge bar on which there is scribed a graduation mark at 7 1/8 inches from its lower end. The surface gauge *D* is first set so that, with its base standing on the top rail of the work-holding fixture, the point of the scriber comes into contact with the centre scribed on the wooden block in the spindle bearing hole. Then the special gauge bar *E* is stood vertically at the centre of the opposite end of the casting, and the surface gauge is moved over so that the position of the spindle centre may be transferred to this gauge. If the horizontal setting of the work is accurate, the point of the scriber will come into contact with the 7 1/8 inch graduation on the gauge bar; otherwise, the horizontal position of the casting must be adjusted by means of the screw on which it is held in the fixture.

Testing Vertical Setting of the Work

One other adjustment is still necessary to bring the work into the desired position for planing, namely, to ascertain whether it is standing in a vertical position. By first placing gauge bar *E* at one corner of the rear end of the casting and testing the position of the graduation line with the surface gauge *D*, and then repeating this test with the gauge bar at the opposite corner of the work, a comparison can be made of the positions of the opposite corners of the casting relative to the horizontal top face of the work-holding fixture. The point of engagement between the scriber on the surface gauge and the graduation line on bar *E* should be duplicated for the two settings if the work is properly located for planing. When all three of these adjustments of the setting of the work have been made, the screws *A* and *B* are finally tightened to maintain the accuracy of the location.

After the casting has been set up according to the previously described method, the outline of the dovetailed bearing to be planed is laid out on the work, in order to indicate the amount of excess metal that must be removed by planing. The first cut across the horizontal surface at the top of the bearing is taken with a round-nosed tool, and then a special rough-dovetailing tool is used on the inclined surfaces. The horizontal surfaces are next finished with a square-nosed tool, and a special finish-dovetailing tool takes the final cut on the inclined surfaces, thus completing the first operation. The production time on this job is forty-five minutes.

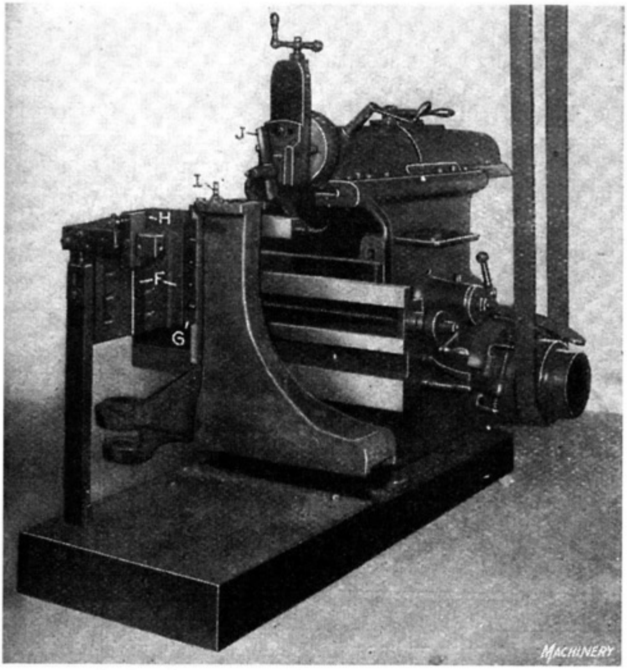
Planing the Bottom Surface on the Top Column

Mention has already been made of the fact that the dovetailed bearing, previously planed on the top column casting to receive the drilling head, is used as the locating point in setting up the work for performing subsequent operations. Fig. 4 shows a 24-inch shaper on which this work is performed, and in this connection attention is drawn to the fact that although the shaper fixture is designed to hold three castings at a time, only one casting is shown in position in order that the arrangement may be more clearly illustrated. The method of setting up the work and the actual machining operation to be performed are quite simple. On the fixture there are three strips *F*, each of which has an inclined surface to bear against the angular face at one side of the dovetailed bearing that has been planed on the column.

After a piece of work has been slipped into place under locating strip *F*, a second adjustable strip *G*, which is secured to the fixture by bolts, is pushed into place against the opposite side of the dovetailed bearing and drawn up tight by the bolts, thus securing one piece of work in place for planing. Three pieces are set up in this way, and when they have all been set up, a clamping screw *H* is tightened to hold them securely in place and to support the end thrust of the tool. The planing operation is quite simple, consisting of facing off the bottom of the casting and of planing a tongue to fit into a groove pinned in the top of the lower column casting.

The sequence of cuts taken during the performance of this operation is as follows. A round-

Fig. 4. A 24-inch Shaper equipped for planing the Base of the columns of Single-spindle Drilling Machines



nosed tool takes a roughing cut at the top of the casting, and the same tool is fed vertically downward to produce the necessary clearance at each side of the tongue. A duplex straddle tool is next used to finish-plane the sides of the tongue, and the accuracy of this job is tested with a snap gauge *I*. Finally, the top of the work is finished with a round-nosed tool which has had a small flat surface stoned on its point. This tool is set at an angle, as shown at *J*, for convenience in reaching the work as it is held in the fixture. The production time on this job is twenty-five minutes.

Final Planing Operation on the Top Column

The final planing operation on the top column consists of planing the dovetailed bearing for the top carriage. This operation is performed on a 24-inch shaper, as shown in Fig. 5. This machine is equipped with a box jig similar to the one used for the first operation, except that the work is set differently. For taking the final cut, the casting is located from the dovetailed bearing planes in the first operation, the arrangement being similar to that explained in connection with the work-holding fixture, illustrated in Fig. 4, with the exception that in the present case the dovetail in which the casting is held is located at the forward end of the fixture.

Castings are brought to this fixture by a trolley hoist and lowered through a space in the top, after which the clamping bolts are tightened. After a preliminary setting has been accomplished in this manner, the weight of the casting at the opposite end is

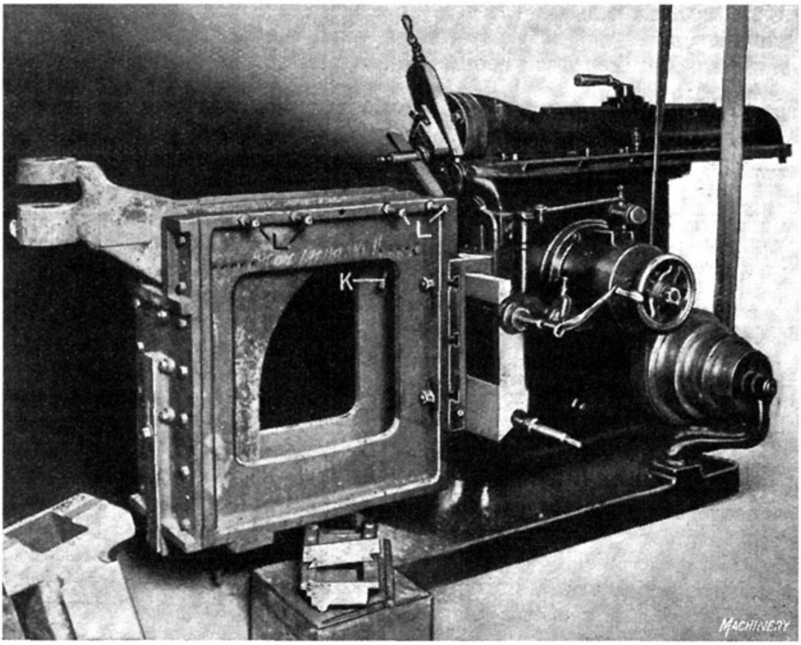


Fig. 5. A 24-inch Shaper equipped for planing Bearing for Top Carriage on Drilling Machine Columns

supported by tightening a screw *K* that engages the underside of the work; and screws *L*, which are furnished with lock nuts, are next drawn up in order to hold the sides of the work and prevent them from springing away from the cut. This is a matter of importance, because the walls of the casting are thin at the point where the dovetailed bearing for the top carriage is planed, and they require support in order to prevent distortion of the work.

After the roughing cut has been taken, it is also a matter of especial importance to loosen up the clamping bolts, which were tightened with a wrench before taking the roughing cut, and then screw these bolts up by hand until their points come into engagement with the casting, after which the lock nut are again tightened with a wrench. The purpose of resetting before taking the finishing cut is to prevent excessive pressure of the bolts, which would spring the work out of shape and destroy the accuracy of the planed surface. On this job, roughing and finishing cuts are taken with the same sequence of tools previously referred to for operations on dovetailed bearings. The production time is seventy-five minutes.

Production Shaping

The Use of Shapers in Production Work in Machine Tool Building Plants - II

MACHINERY - DECEMBER 15, 1921

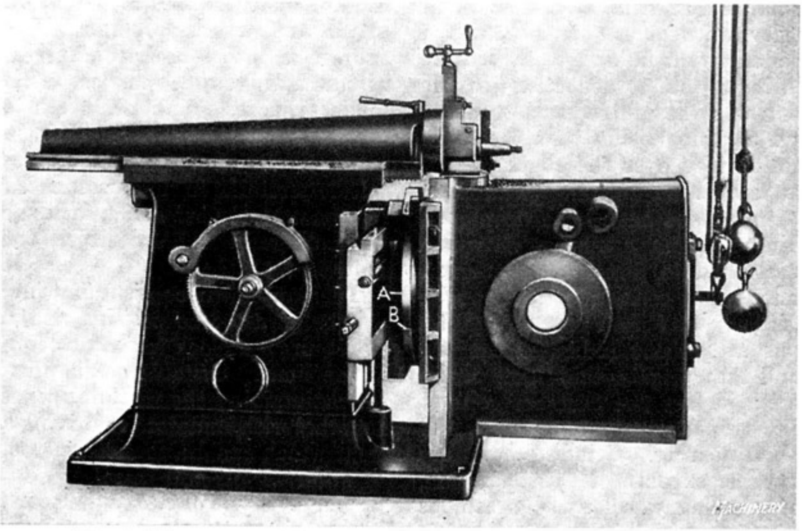


Fig. 1. Fixture used in holding Column Casting of a Shaper for planing Four Sides of the Work at a Single Setting

In the first instalment of this series of articles dealing with the use of shapers on production work, attention was called to the various advantageous features of machines of this type. There are many parts of small or medium size, for the planing of which the shaper is especially well adapted. Typical examples of such work are illustrated and described in this article; in addition to showing the range and flexibility of the shaper, the methods are of general application, so that they could be applied with equal success on many other lines of work, for reducing costs and increasing production.

Planing Shaper Column Castings on the Shaper

On Steptoe shapers the ends of the column castings are planed, but this work was formerly done on a shaper. Little thought will be required to make it apparent that work of this kind is too large to be advantageously handled on this type of machine; but the present example clearly shows the capacity of a shaper in an emergency. Fig. 1 shows this job set up on a triple-geared shaper.

A fixture *A* is hung on the shaper cross rail in place of the apron, which provides for feeding the work transversely or for

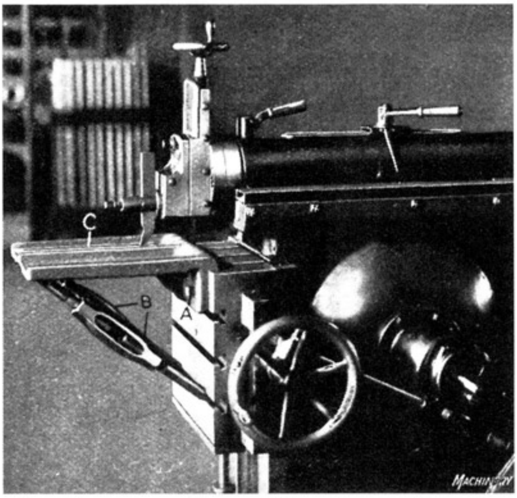


Fig. 2. Method of setting up Shaper Table Support for performing a Short Planing Operation on the Shaper

adjusting its vertical position; the fixture is also provided with a graduated swivel, so that the work may be adjusted for planing different surfaces. This is the means of effecting a substantial saving of time in setting up these castings, because after the end of the shaper column has been planed, as shown in the illustration, it may be swivelled through 90 degrees for planing the ends of the bearing bosses that carry the transverse shafts. Then the work can again be swivelled through 90 degrees to bring the opposite end of the casting under the tool for planing the bearings for the cross rail, after which a third swivelling of the work brings the opposite side into position for planing.

Thus it will be apparent that all four sides of the work can be planed at a single setting, and even though the shaper may be a little slower than the planer, the possibility of completing all the machine work at a single setting would offset the difference in speed, so far as the total production is concerned. Notches are cut in the flange of the rotary fixture, one notch being shown at *B*, so that the column can be properly located in successive positions for performing the planing operations.

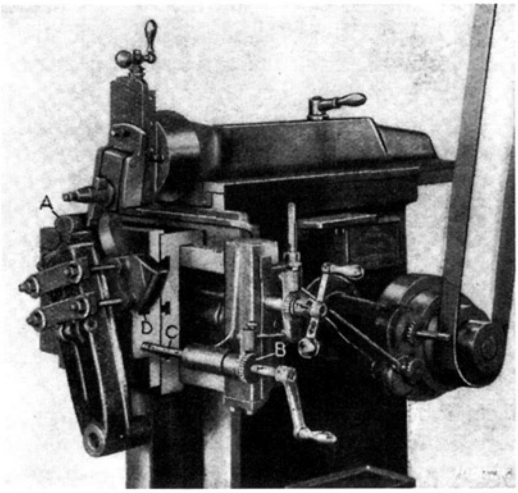


Fig. 3. Use of Rotary Fixture for holding Shaper Rocker Arm to guide Work for shaping Bearing *A*

Planing Shaper Table Support

In Fig. 2 a shaper is shown set up for planing the table support of a shaper. This would be a rather difficult piece to hold on any other type of machine, and experience has shown that the work can be done to the best advantage on a shaper. It will be seen that the shaper table has been removed, and that holes have been drilled and tapped in the apron to receive two bolts *A* which hold each casting in place while the operation is in progress.

A method of this kind constitutes a simple means of attaching the work to the machine, but obviously there would be too much overhang if some adequate form of outboard support were not provided. For this purpose, two jacks *B* are utilized, one end of which is entered into T-slots in the apron, the opposite ends engaging a flange in the outer extreme of the work. The planing operation is not unusual, use being made of a round-nosed tool for taking a roughing cut on the area surrounding the slot *C* in the table support, and a square-nosed tool for performing the finishing operation.

Planing a Shaper Ram

In the illustration Fig. 4 is shown a 20-inch Hendey crank shaper, which is equipped for performing a planing operation on the top of the ram for a shaper. The point of special interest in this connection is the

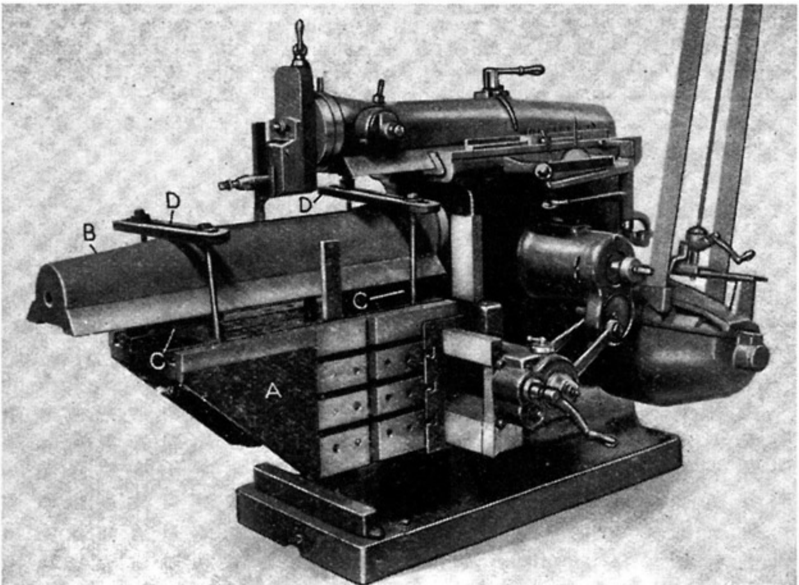


Fig. 4. Use of a Table Extension to afford Outboard Support for a Shaper Ram while performing a Short Planing Operation

application of an extension table *A* for handling long pieces of work. This table extension is a substantial casting of triangular outline. The top or working surface is of uniform thickness and has T-slots corresponding with the top surface of the regular table. The side supporting walls of the extensions are undercut, to save metal. The dividing line between the main table and the extension is shown by the termination of the T-slots on the side. The extension is fastened to the front end of the table by means of five bolts and two tapered dowel pins, so it can be readily taken off when desired, and replaced in perfect alignment.

The shaper ram *B* has had the dovetailed bearing planed on its underside before being set up on the shaper for performing the operation here illustrated. The casting is set on two parallel blocks *C*, and held down by bolts entering the table T-slots and straps *D* extending over the top of the work. The planing operation consists merely of taking roughing and finishing cuts over the flat surface surrounding the slot at the top of the ram.

Planing Rocker Arms

On the so-called "stroke" or rocker arm for the single-geared shapers built by the Springfield Machine Tool Co., there is a cylindrical member *A*, Fig. 3, at the top, which is machined to the required form on a shaper equipped as shown. The machine is furnished with a special rotary fixture that provides for revolving the work as the tool reciprocates across it, thus generating a cylindrical shaped pivot *A* of the required form.

The fixture is so arranged that it is only necessary to set the casting in position and locate the cylindrical pivot that is to be planed from a round disc on the fixture. This disc is directly behind the work, and serves the double purpose of locating the casting, and of providing a reference point from which the tool is set in order to plane the work to the required size. It will be noticed that the circular feed is taken from an auxiliary ratchet *B* connected to the feed mechanism of the shaper, and transmitted through a worm on shaft *C* that meshes with worm wheel *D* on the fixture. The operation is performed at a single cut, with a very fine feed, and it requires about forty minutes to set up the casting and finish it to the required form.

Shaping Operations on a Shaper Rocker Arm

In machining rocker arms that transmit motion from the crank to the ram on shapers built by the Queen City Machine Tool Co., it is required to face off the bearing bosses on the inside of a yoke at one end of these castings. The operation, as performed on a 24-inch shaper, is shown in Fig. 5. The side of the rocker arm that rests against the table, and the wide slot for the crank-pin sliding block, are machined previously. The work is

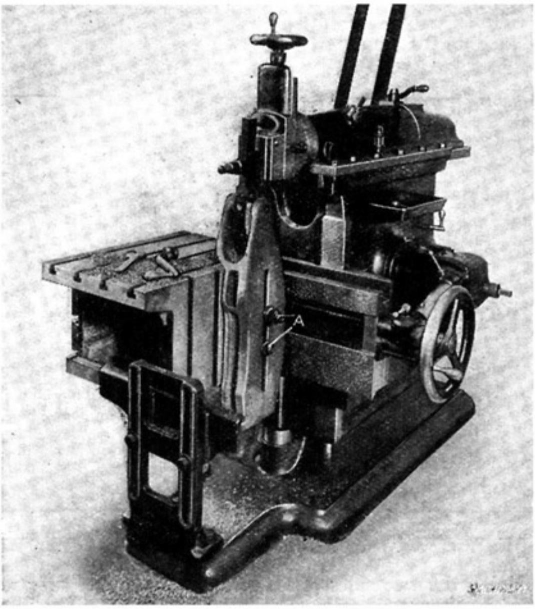


Fig. 5. Application of a Duplex Tool for simultaneously planing Inside Faces of Yoke Bosses on a Shaper Arm

drawn squarely against the side of the table by the two bolts *A*, and the thrust of the cut is taken by a long block fitted to the slot in the rocker arm and bolted and tongued to a vertical T-slot on the side of the table.

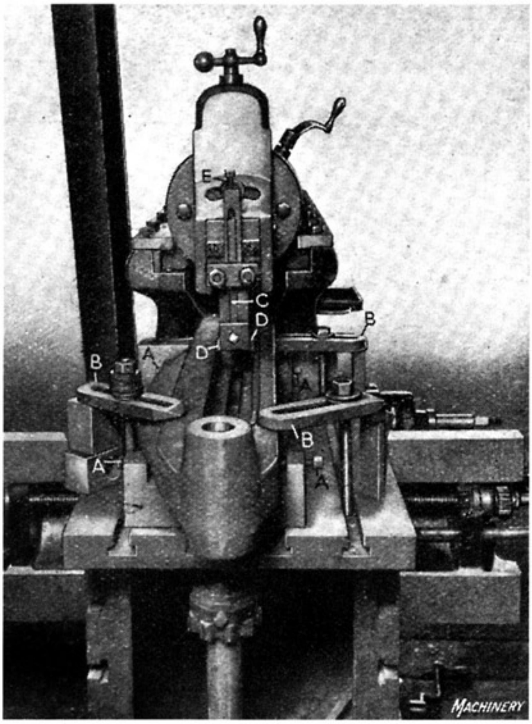
After the work has once been set up, the table remains in this position, the operation of facing down the two opposite bosses being performed with a tool holder carrying two cutter bits that machine the faces of the bosses simultaneously. A roughing and a finishing tool are employed, and a tool-setting gauge is used to ensure the correct relation between the tool and the finished face on the side of the arm. The simplicity of the holding devices, as well as the adaptability of the shaper for this job, enables an average production time per piece of only six minutes to be attained.

Planing the Slot in a Shaper Rocker Arm

Fig. 6 illustrates the operation of finishing the slot in the arm that receives the sliding crank block. It will be seen that a tool holder with two cutter bits is used for simultaneously machining the two sides of this slot in order that they may be finished parallel with each other and with exactly the required spacing between the sides. This is a regular production job, and the special work-holding fixture shown in the illustration is used for holding the work.

Mention has previously been made of the three-point principle for obtaining a preliminary support for rough castings, in order to compensate for slight inequalities in their size, and to ensure obtaining a firm foundation for the work. This fixture has three screws by means of which the casting is levelled up, the correct setting being determined with a surface gauge; and after this part of the setting has been accomplished, the work is lined

Fig. 6. Crank Shaper equipped for simultaneously planing Sides of Slot in Rocker Arm for a Shaper



up in the fixture by the adjustment of four screws *A*, which also tend to hold the work against sidewise movement. Tests for accuracy of alignment are made from the edge of the table to the work with a surface gauge. Final clamping is accomplished by means of straps *B* that hold the work down on the fixture. After the casting has been levelled up and brought into alignment with the line of travel of the shaper tool, the tool is centred over the work by the regular adjustment of the saddle on the shaper cross rail.

Both the roughing and the finishing tools are of the double point type shown in Fig. 6, but the finishing tool is required to bring the width of the slot to exactly the desired dimension, and in order to compensate for wear that occurs in sharpening, there is a wedge *C* that is forced down between the two cutter bits *D* by means of an adjusting screw *E*, so that the tools may be adjusted to plane the slot to exactly the required width. For both the roughing and finishing operations, the feed is 0.032-inch, and the cutting speed 35 feet per minute. The time required for this operation is one hour and a half, which includes the time necessary for planing the horizontal top face of the rim which surrounds the slot.

Performance of String Planing Operation on a Shaper

In many plants where there are limited numbers of small and medium-sized parts on which it is required to plane the faces of bosses and to perform similar operations, it will be found that a shaper is well adapted to the requirements of such work. Fig. 7 illustrates a 28-inch back-geared shaper with single-pulley drive, which is used for planing both sides of bosses at opposite ends of short links of the form shown clamped to the table of the machine. It will be seen that eight of these pieces are set up at a time, and there are four faces to be finished on each link.

The operation is quite simple, consisting of taking a roughing cut with a round-nosed tool and a finishing cut with a square nosed tool. The method of setting up the work is also simple, and is well shown in the illustration. A bar *A* is utilized as an end stop, and this serves the double purpose of squaring up the work with the line of travel of the ram, and of supporting the end thrust of the tool. It will be seen that straps and bolts *B* are placed between each pair of castings to hold them down on the table, and small blocks *C* are put between the ends of each pair of links, because these pieces of work are larger at the centre than at the ends, and if some precaution of this kind were not taken there would be a tendency for the thrust of the tool to swing them about their central points. For taking roughing and a finishing cut on both sides of both ends of eight of these links, that is to say, planing thirty-two faces, the production time is about one hour and twenty-five minutes.

Application of the Shaper for Keyseating Bronze Sleeve Gears

Another application of a shaper is shown in Fig. 8. This is a keyseating operation in the bronze sleeve gear. In this illustration one of the gears is shown lying on the table, and a second gear will be seen in place.

The tool holder *A*, mounted in the shaper ram, is made of sufficient length so that it can be reciprocated through the axial hole in the gear and its shank. The attachment is provided with a vertical table *B* having T-slots planed in it for attaching various work-holding fixtures. In the present instance the fixture consists of a block *C*, bolted to the table and provided with two clamping bolts and

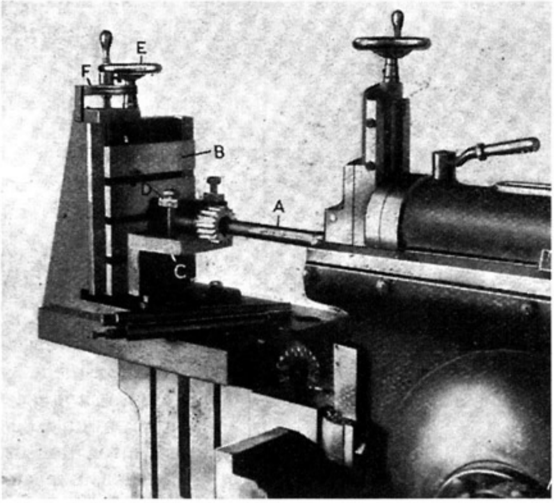
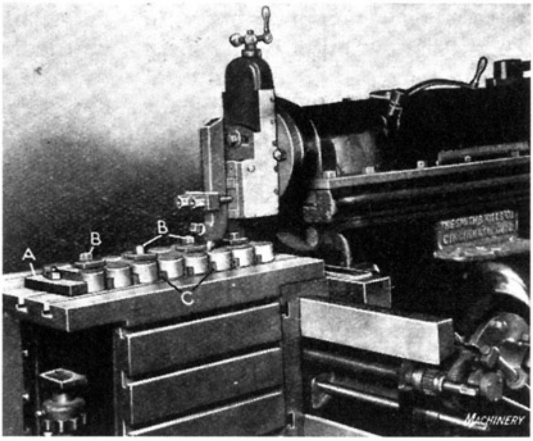


Fig. 7. Use of a Keyseating Fixture for Machining the Keyway in Bronze Sleeve Gears for Shapers
[NOTE: Fig. 7 and Fig. 8 were transposed in the original article]

Fig. 8. Crank Shaper equipped for planing the Bosses on a String of Eight Shaper Pendulum Links

[NOTE: Fig. 7 and Fig. 8 were transposed in the original article]



a strap *D* for holding the work down. The position of the vertical table *B* is adjusted by a screw having a hand wheel *E* on the end. A stop screw that is positioned by a graduated dial *F* enables the depth of the keyseat to be accurately controlled.

Indexing Shaper Fixture for Planing Gear Boxes

In Fig. 9 is shown a shaper employed for short planing operations on gear boxes. It will be seen that the gear box casting *A* is set up in a box-type work-holding fixture pivoted at *B*. An index pin provides for locating the fixture in successive positions, so that planing operations may be performed on three sides of the work without requiring the casting to be reset. This is the means of effecting a substantial saving of time in the performance of planing operations.

Fig. 10 shows an outline drawing of the gear-box casting. It rests on the trunnion fixture on fixed supports which make contact with the casting at points *A*, *B*, *C*, *D*, *E* and *F*. Point *G* rests on a support which is adjustable to compensate for variations in the cast-

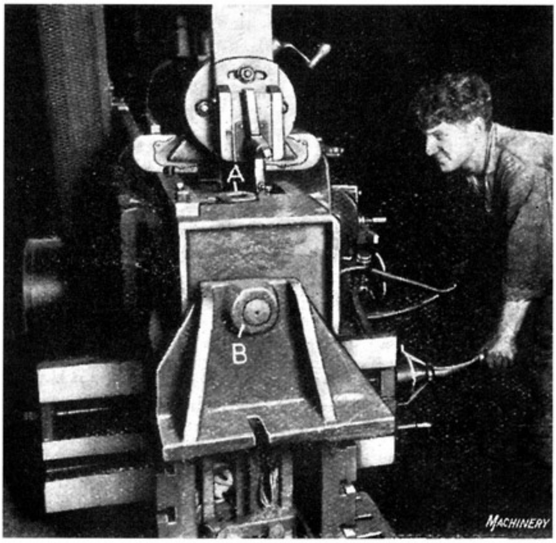


Fig. 9. Using an Indexing Shaper Fixture for planing Gear Boxes

ing. The latter is clamped in place in the fixture by set screws located directly opposite the supporting points to eliminate distortion. The first operation on the part consists of roughing and finishing the top surface *X*; the second operation consists of roughing and finishing the back surface *Y*; and the third and final operation consists of roughing and finishing front surface *Z*. Means are provided on the fixture for accurately and quickly setting the tool so that the three finished surfaces are machined in the correct relation to the rough casting.

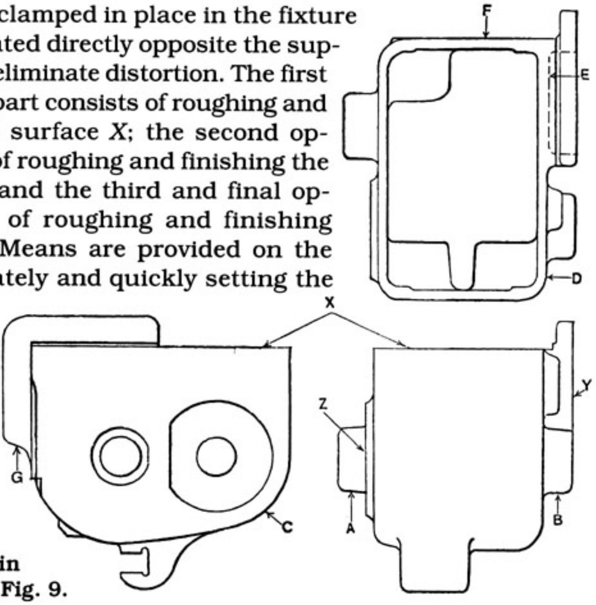


Fig. 10. Outline of Gear Box planed in Fixture shown in Fig. 9.

Production Shaping

The Use of Shapers in Production Work in Machine Tool Building Plants - III

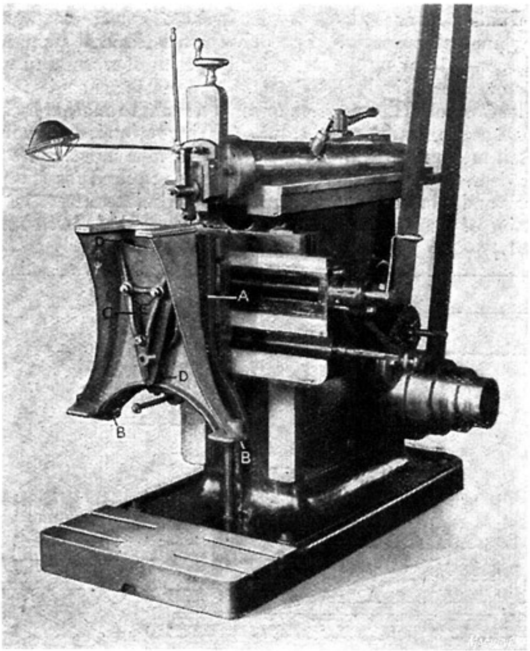
MACHINERY - DECEMBER 22, 1921

The shaper is a machine having sufficient flexibility to adapt it for handling a wide range of production work, provided care is taken in the planning of operations and in the designing of tools and fixtures. The following article illustrates the application of shapers for the performance of miscellaneous manufacturing operations in machine tool building plants. All the methods referred to involve the use of principles of general application, so that although these methods are applied to the manufacture of parts of machine tools, they could be utilized with equal success in plants handling various other classes of work.

Planing the Legs of Springfield Lathes on the Shaper

It is the regular practice of the Springfield Machine Tool Co., U.S.A., to use shapers for planing lathe bed legs. In Fig. 1 a shaper is shown equipped for this operation, and it will be seen that the table has been removed so that a fixture *A* may be bolted

Fig. 1. Shaper equipped for a Short Planing Operation on the Legs of an Engine Lathe



to the saddle, this fixture being of much the same shape as the lathe bed legs. There are two projecting feet *B* on which the casting rests until it has been secured in place.

The cast-iron member *C* of the clamping mechanism carries three hardened plugs (two of which are shown at *D*); these plugs are held in contact with the lathe bed leg casting by three bolts *E*, thus clamping the casting in place on the fixture. The simplicity of the arrangement makes it possible to employ apprentices to do work for which high-priced mechanics might otherwise be required. These lathe bed leg castings are generally rather hard, and for that reason the cutting speed is kept within conservative limits, so that the figures given in the following do not represent maximum production. The cutting tool is carried by a holder and located behind the point of support, as it has been found that a tool of this type gives better results than are obtained with a straight one.

In planing these lathe legs, the work consists of taking roughing and finishing cuts. There are two surfaces to be planed at the top of the work; on a 16-inch lathe, these surfaces measure 12 inches long by 3 inches wide. A round nosed high-speed steel tool is used for taking the roughing cut at a speed of 50 feet per minute, with a feed of 0.011-inch per stroke, and a depth of cut of about 1/8 inch. The finishing cut is taken with a round-nosed stellite tool of a greater radius of curvature than the one employed for roughing. This tool is operated at the same cutting speed, but with a feed of 0.008-inch per stroke and a depth of cut of about 1/16-inch. Approximately one-half hour is required to set up and plane a casting by the method described.

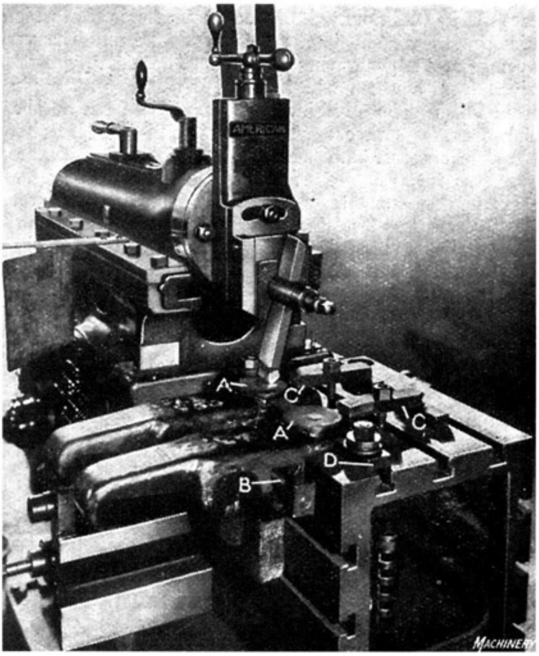


Fig. 2. Shaper equipped for planing the Faces on Bosses on Screw Supports for Engine Lathes

Facing Bosses on Lead-screw Supports

A rather simple surfacing operation is shown in Fig. 2, which illustrates the use of a 16-inch shaper for rough and finish-planing a circular boss *A* on the lead-screw support for an engine lathe. A roughing cut is taken with a round-nosed tool at a speed of 45 feet per minute, using a feed of 0.032-inch, and leaving 0.006-inch of metal for removal by the finishing cut, which is taken at a speed of 45 feet per minute, with a feed of 1/2-inch. The production time on two pieces of work which are set up for simultaneous machining is ten minutes.

The method of setting up the work is the point of particular interest in this job. As the castings come to the machine, they have been planed on their underside, forming a finished right-angled shoulder that is located against the corner of the shaper table. The two pieces of work are held against the side of the table by means of a bar *B*, which passes through cored openings in the castings and is drawn toward the table by means of clamping bolts (not shown in the illustration). The work is held down on top of the table by straps *C*. The thrust of the cutting tools is taken by an end stop *D*.

Planing Milling Machine Knees on the Shaper

In machining knees for Steptoe hand milling machines, a practice is made of planing the dovetailed bearing for the saddle, with the work set up on a shaper. As the castings come to this machine, the back of the knee has been planed so that it may be used as the locating surface. The table is removed from the shaper and the milling machine knee to be planed is clamped directly to T-slots in the apron.

This operation, as shown in Fig. 3, consists of planing the dovetailed bearing for the saddle on the knee, roughing and finishing cuts being taken, as in the preceding cases, with the standard forms of tools employed for this purpose. This is a regular production job.

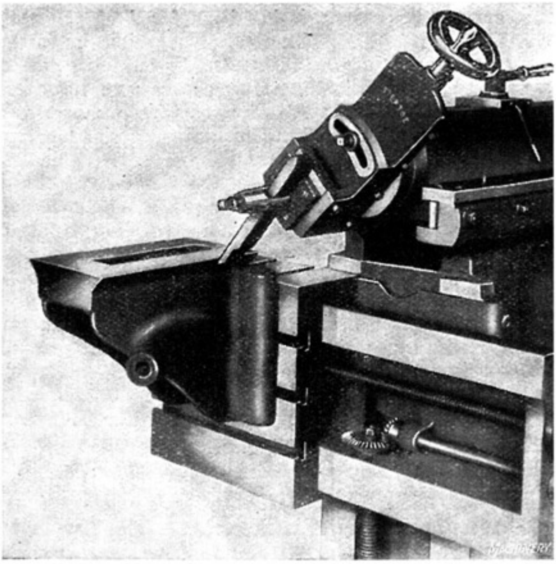


Fig. 3. Use of Shaper for planing the Dovetailed Saddle Bearing of a Hand Milling Machine Knee

Shaping Grinder Driving Shaft Brackets

On Queen City grinding machines the main driving shaft located at the back of the machine is supported by brackets of the form shown set up on a shaper table in Fig. 4. While held in this way it is required to plane surface A on the casting. An interesting feature of this job is the provision made for holding pieces of work that are of rather an unusual form. The work is held in an offset jaw vice mounted on top of the shaper table, and an auxiliary bracket *B* is bolted to the finished side of the table to support the bearing boss, which would otherwise overhang and cause severe vibration while the cutting tool is at work. The upper part of the casting is further supported by a jack screw *C* that is furnished with lock nuts, so that it may be raised under the corner of the casting and clamped in position to support a section of the work that is too thin and flexible to withstand the pressure of the tool without this additional support.

After the casting has been set in the vice and lined up ready for planing, hard wood wedges *D* are driven in between the surface of bracket *B*, and the underside of the bearing boss, in order to afford a secure foundation. In the illustration the roughing cut is being taken on the face of the bracket with a round-nosed tool. The sequence of operations is quite simple, consisting of the planing of this face of the casting and the forming of a tongue that fits into a corresponding groove planed in the bed of the grinding machine.

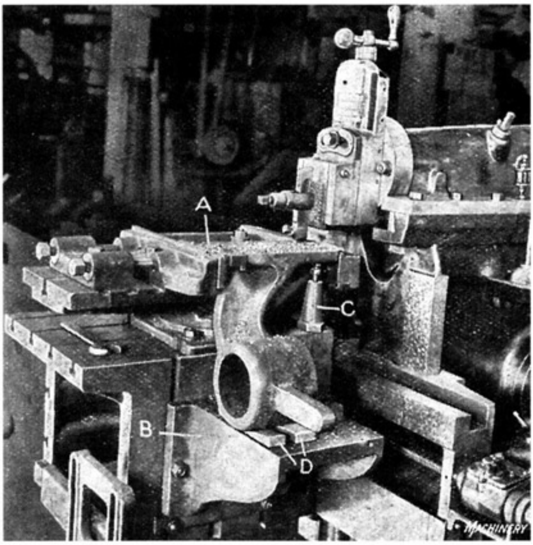


Fig. 4. Pland and Tonguing the Face of a Grinding Machine Driving Shaft Supporting Bracket

After the roughing cut has been completed, a finishing cut is taken with a square-nosed tool. The tongue is finished to the required width with a duplex tool which straddles the tongue and simultaneously finishes its two sides. The operation takes twenty-one minutes.

Shaping Front Plates for Planer Frictions

In Fig. 5 is shown the work of planing a piece known as the "front plate" for an American planer friction. As the work comes to this shaper, it has been faced on the underside, and a fixture of the form shown is employed, because there is a boss on the bottom of the work, for which a clearance space must be provided in the fixture; otherwise, it would be practicable to strap this piece directly to the shaper table. The job consists of rough and

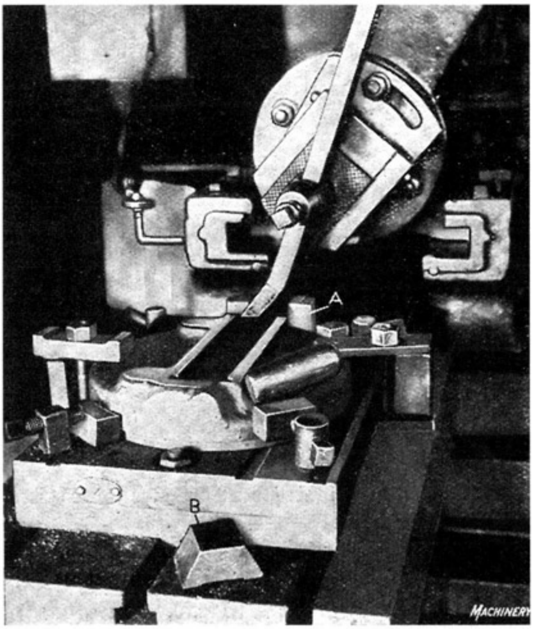


Fig. 5. A 24-inch Shaper equipped for planing the Dovetail Bearing and the Horizontal Face of Front Plates for Planer Frictions

finish-planing the horizontal surface which surrounds the dovetail bearing, and also rough and finish-planing the bearing. As the shoulder at the end of the dovetail makes it impracticable to handle more than one piece of work at a time, it is not possible to apply the principle of setting the work up in a string for planing, and consequently this may be regarded as a production job for which the shaper is particularly adapted.

At best, the planer could operate only on one piece at a time, for the reasons mentioned, and the positive stroke control of a shaper is a desirable feature when the tool traverses almost into contact with a shoulder on the work, as in the present case. At the back of the fixture on this machine is a tool-setting gauge A used in setting the tools for operation on both the horizontal top face of the work and on the inclined surfaces of the dovetail. The method of procedure is first to rough the top face with a round-nosed tool, and then take a finishing cut with a broad square-nosed goose-neck tool.

Next, a dovetail roughing tool is used for taking the first cut on the inclined faces of the bearing, after which a finishing tool is substituted for the final operation. The dovetail bearing is required to be accurate within 0.001-inch. For testing the work after the finish-plaining operation, a gauge *B* is used, which is coated with a thin film of red lead and inserted in the bearing in order to test the accuracy of the form and the straightness of the inclined sides. All operations are performed at a cutting speed of 55 feet per minute. On the horizontal surface, the feed for roughing is 1/8-inch and for finishing, 3/4-inch; on the inclined faces of the dovetail, the feed for the roughing cut is 0.020-inch, and for the finishing cut 0.250-inch. There is an allowance of 0.006-inch of metal for the finishing cut. On this job an operator can

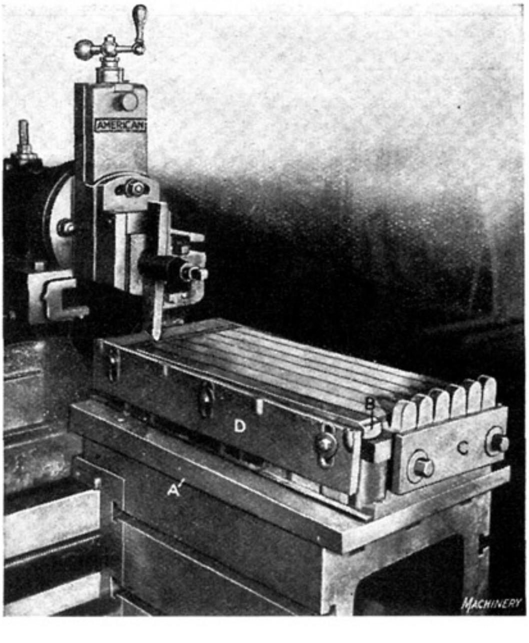


Fig. 6. A 24-inch Shaper equipped for planing the Tapered Face of Gibs held on a Magnetic Chuck

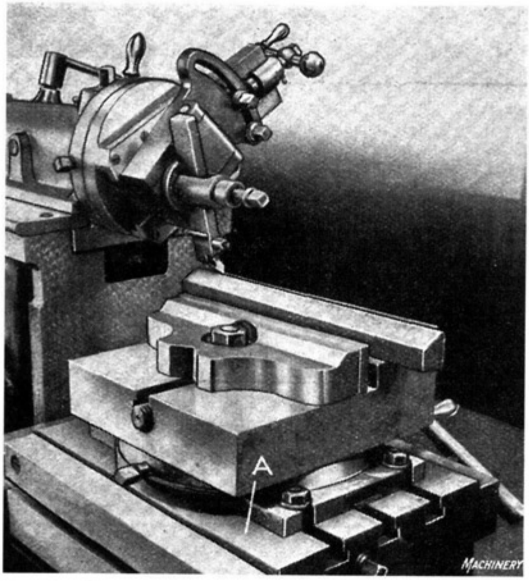


Fig. 7. Method of planing Double-angle Gibs

finish five pieces in eight-and-three-quarter hours.

Planing Tapered Gibs on a Shaper

In the plant of the American Tool Works Co., 24-inch shapers of this company's manufacture, which are equipped with magnetic chucks, as shown in Fig. 6, are used for taper planing operations on various types and sizes of gibs. The sides and straight underside of the gib are machined before the work is set up for planing the tapered side. It will be seen that six gibs are set up on the magnetic chuck at one time. In order to obtain the required location for the taper planing operation, a master plate *A* is placed between the shaper table and the chuck; this tilts the chuck to the proper angle, so that horizontal strokes of the shaper tool will result in planing the top face of each gib at the required taper to the previously finished lower side.

These gibs are required to be accurate, after finish-planing, within 0.001-inch from end to end. Hence it is important to set up the magnetic chuck on the tapered foundation plate *A* in such a way that the angle of the work will be brought within the required limits. For checking the set-up before planing, a master gib *B* is used, which is placed on the face of the magnetic chuck, a dial indicator being mounted in the shaper toolpost. This master gib is accurately planed, so that if the chuck has been properly set up, the indicator will give a uniform reading from end to end of the gib *B*. Any error which is discovered in making this test is corrected by placing one or more sheets of packing paper between the shaper table and the plate *A* at the low end. Then the operator can set up six of the gibs ready to be pinned.

Provision for supporting End Thrust

The magnetic chuck is furnished with an end plate *C* and a side plate *D* for the double purpose of assisting in locating the work against its previously planed side faces, and of supporting the end thrust of the tool that could not be carried by the holding power of the chuck. A roughing cut is taken over the work with a round-nosed tool, using a cutting speed of 55 feet per minute with a feed of 0.035-inch. For finishing, a round nosed tool is used, the end of which has been slightly flattened by rubbing it down on an oilstone. This tool is also operated at a cutting speed of 55 feet per minute with a feed of 0.030-inch.

With an equipment of this kind, the setting fixtures may be depended upon to hold the work within accurate limits, after the original set-up has been made by an experienced mechanic. Consequently, it is found economical to employ a semi-skilled operator on this job, and it is for that reason that the finishing cut is taken with a tool of the type described. Otherwise, it would be regarded as better practice to employ a broad square nosed finishing tool of the goose-neck type, with a feed of from 1/2 to 3/4-inch per stroke. The production time for the rough and finish-planing operations on the tapered side of six gibs is thirty minutes.

Shaping a Gib having a Double Taper

Fig. 7 shows how a shaper can be utilized for machining a piece of work on which there is a double angle. The piece shown in process of manufacture is a tapered gib on which a 45-degree angle is required to fit the dovetailed bearing of the slide, while the usual lengthwise taper is also provided. On the Potter & Johnston shaper there is a tilting flap, shown at *A*, at the top of the table, which can be raised to any required angle in order that the surface of the work being machined can be planed at any desired angle with the lower surface of the work that is

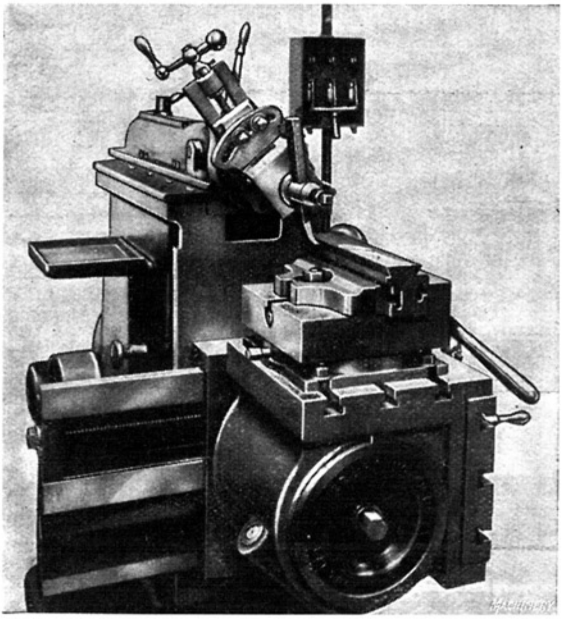


Fig. 8. Planing Inclined Side Face of Dovetailed Slide Bearing

clamped to the table. It is this application of the tilting flap that provides for obtaining the lengthwise taper on the work; and by setting the tool-head at an angle of 45 degrees, the single-point tool may be fed down the inclined side of the work, thus obtaining the desired form.

Shaping the Angular Sides of a Dovetailed Slide

Fig. 8 shows the method used in shaping the angular sides of a dovetailed slide bearing on a Potter & Johnston shaper.

This job is similar to the one illustrated in Fig. 7, in so far as the planing of the 45-degree angular sides is concerned. It will be noticed that the tool head is set at an angle to give the desired form to the work, but there is one noteworthy difference in this case, which is that the tool is required to cut on the underside of the inclined face instead of at the top. Consequently, the tool had to be forged with an offset on which the cutting point is ground, so that there will not be any interference between the side of the tool and the work. In Figs. 7 and 8 it will be seen that the pieces to be machined are secured in an ordinary shaper vice.

Cutting a Tongue Slot with a Shaper Tool

Fig. 9 shows a Potter & Johnston shaper on which the dovetailed bearing for a slide has just been machined at the setting illustrated. After completing this part of the work, the table is moved over to provide for cutting a tongue slot; the tool is shown engaged in the performance of this operation in the illustration. For this job the tool is made of a width to take the cut with only a vertical feed movement.

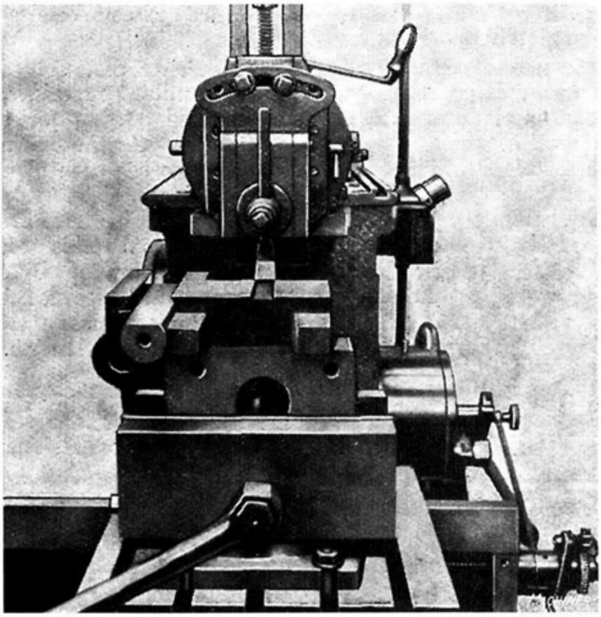
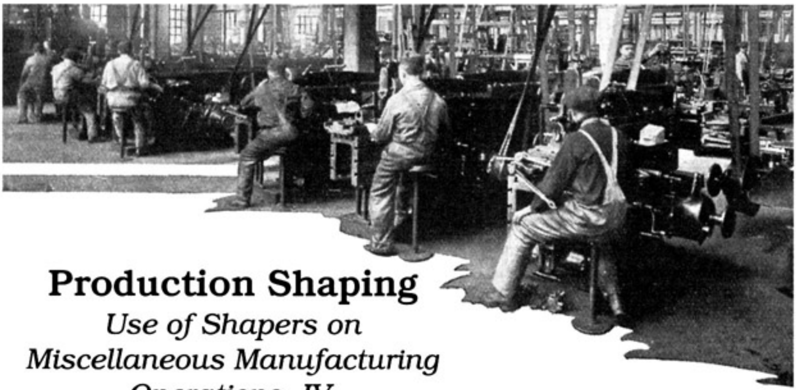


Fig. 9. Use of a Broad Square-nosed Tool for planing a Shallow Slot in the Work



Production Shaping

Use of Shapers on Miscellaneous Manufacturing Operations- IV.

MACHINERY - FEBRUARY 2, 1922

Although the principal field of application of shapers is in tool-room and experimental and repair shop work, machines of this type are now being used for many detail operations which must be performed in the manufacture of metal parts. For instance, one well-known maker of firearms has twenty-five crank shapers in the production departments of his plant, and this is but one of many examples that could be cited. The following article illustrates and describes the performance of miscellaneous manufacturing operations on the shaper, and will tend to emphasize the applicability of a machine of this type as a standard form of equipment for production work.

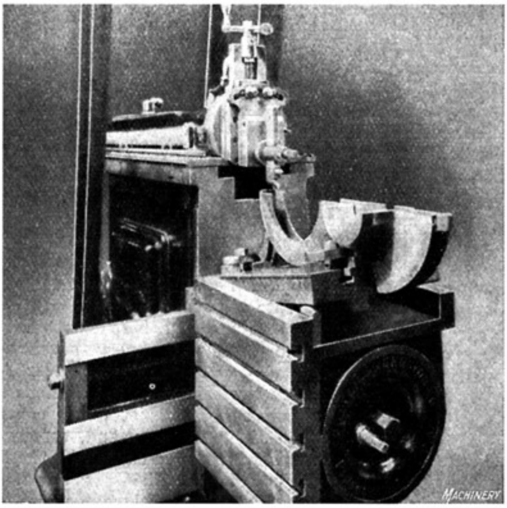


Fig. 1. Application of the Tilting Shaper Table Flap for obtaining a Specified Angular Relationship between Two Finished Surfaces on the Work

Application of the Tilting Table Flap for Shaping an Inclined Surface

Fig. 1 illustrates a typical application of the tilting table flap of the Potter & Johnston shaper. This construction provides for obtaining a specified angular re-

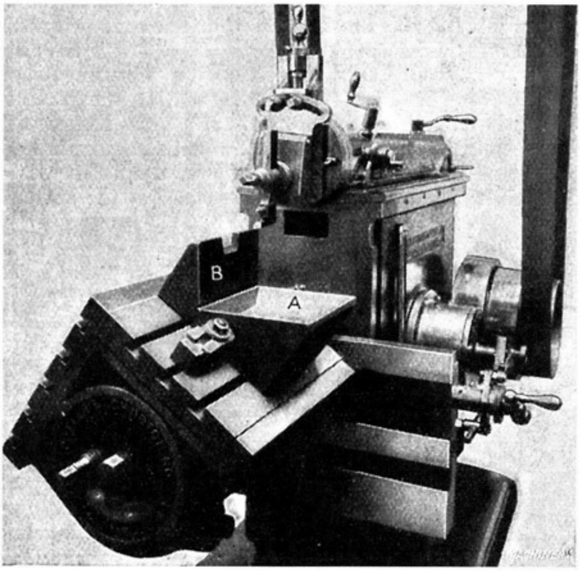


Fig. 2. Application of the Swivelling Table for obtaining a Definite Angular Relationship between Two Finished Surfaces on a Piece of Work

lationship between the under surface of a piece of work that rests on the shaper table and the top surface that is being planed by the cutting tool. In this case, the piece to be machined is a cast-iron gear guard, the feet of which are bolted down to the table by means of clamping straps. By tilting the table flap, the top surface of the gear guard is finished at the required angle with the plane of the feet.

Use of Swivelling Table for Shaping Two Surfaces at an Angle with Each Other

Still another adjustment to provide for obtaining definite angular relationships between two surfaces of the work is illustrated in Fig. 2. The piece shown on the machine is a cast-iron bracket on which two surfaces are shaped at an obtuse angle to each other. The shaper table is carried on a pivotal support, so that after one surface has been finished, the table can be swivelled through any required angle for finishing a second surface-at a specified angle to the one previously machined without resetting the work. In the present case, surface *A* was finished first, after which the table was swung over to the position shown for shaping surface *B* with a vertical downward feed of the tool. The shaper tool is forged with an offset in order to avoid any interference between the tool and the work. It will be seen that the casting is strapped down on the shaper table.

Shaping Both Sides of a Wide Slot Simultaneously

The piece of work illustrated on the machine in Fig. 3 is a sliding block used on a piston-turning machine. The operation consists of finishing the two vertical walls *A* of a wide slot, with a specified clearance between them. This job is interesting for two reasons. The two trunnions

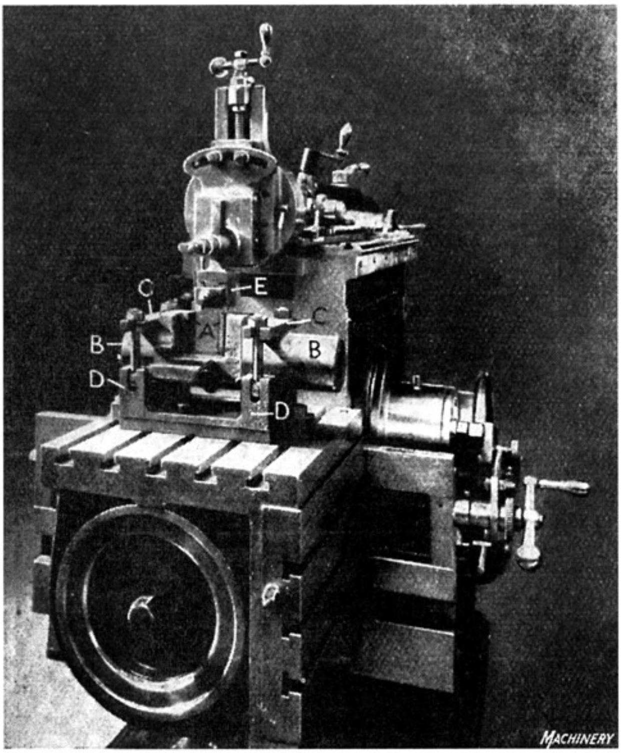
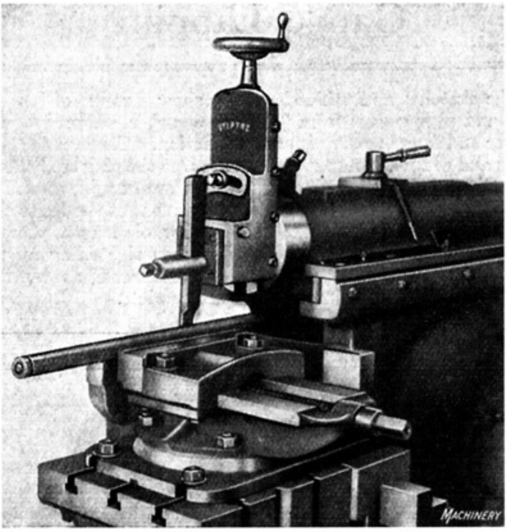


Fig. 3. Use of a Duplex Tool Holder for finishing Two Sides of a Wide Slot simultaneously

B have been turned before the piece comes to the shaper, and they are utilized as locating points by having a V-block fixture bolted to the table with straps *C*, which hold the trunnions down in the vees *D*. With the work located in this way, the two sides *A* of the slot are finished simultaneously by means of a tool holder *E* that supports two cutter bits extending in opposite directions. The slots in which these bits are carried in the tool holder are inclined sufficiently so that the points of the tools will operate without interference between the tool holder and the work.

(below) Fig. 4. How the Shaper is used for Cutting a Long Keyseat



Cutting Long Keyways on the Shaper

In cases where it is

required to cut long keyways, or spline grooves, the shaper may often be employed advantageously. Such a case is shown in Fig. 4, where the shaft is held in a vice bolted to the shaper table. The work is done with a tool of the same width as the keyway or spline groove, the latter being produced by feeding the work up to the tool until the groove has been sunk into the work to the required depth. If an exceptionally smooth finish is required on the sides, it may be found desirable to take a second cut with a slightly wider tool.

Many men of experience in the planning of machining operations would regard this as a job for which the milling machine would be peculiarly well adapted. Local conditions would affect the results, but the setting-up time would be approximately the same, and it is probable that there would be little difference between the actual time required to form the groove with either a milling cutter or a shaping tool.

Fig. 5 is a close-up view of one end of a very heavy steel roll on which it was necessary to plane the semicircular grooves that are used for driving the roll. The operation is practically impossible to perform except by using a shaper that is adapted for this work. In this particular instance, the roll was brought to the machine by a crane and set in the proper position with the inner end supported by a cradle *A*, which is mounted on an adjustable jack to locate the work. The cross rail and table of the shaper were removed as will be seen in the illustration.

The shaper is provided with a traverse head having automatic horizontal and vertical feeds similar to a planer, and has sufficient adjustment to make it possible to plane the grooves without difficulty and in much less time than by any other method. In some shops where motor-driven shapers are used, it is found easier to transport the shaper to the work on account of the weight of some of these rolls.

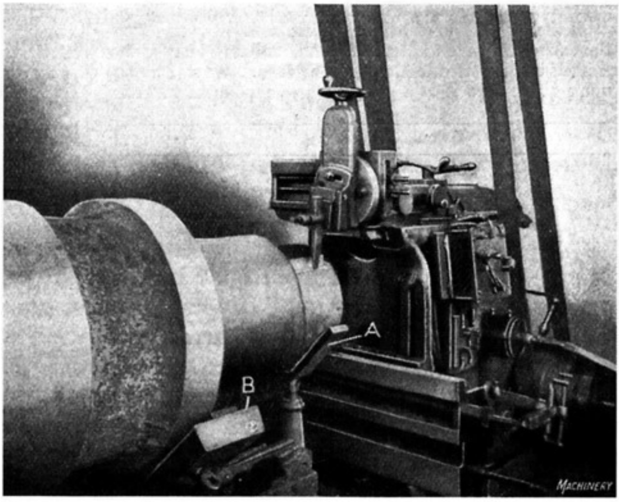
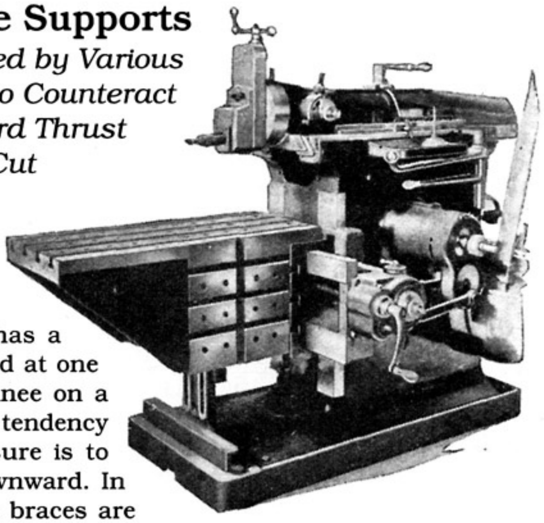


Fig. 5. How a Traverse-head Shaper is used for cutting Integral Key

Shaper Table Supports

Devices employed by Various Manufacturers to Counteract the Downward Thrust of the Cut

By Fred Horner
MACHINERY
NOVEMBER 16, 1922



As the shaper has a work table supported at one end only, like the knee on a milling machine, the tendency of the cutting pressure is to spring the table downward. In the milling machine braces are added to tie the over-arm to the knee, and often the latter to the base, these provisions compensating largely for the one-sided design of the knee. In the shaper this provision was neglected, until the introduction of high-speed steels and high-production rates forced consideration of this matter.

Points to be Considered in Providing a Support

Part of the table deflection due to the pressure of the cut can be prevented by an improved design of the gib arrangements, in which the top gib is of wedge shape, so that additional stresses on the table help to pull it harder against the contact faces. With the draw-cut shaper, the thrust of the tool is directed toward the column, and there the table is pushed against the saddle. But no device entirely prevents deflection so long as the table is unsupported near the extended end, as even the weight of heavy work will produce some deflection before the tool pressure is applied. An additional table support is therefore advantageous, not only to keep the table in the proper position under all circumstances, but also to relieve the saddle cross rail and fastening devices of unnecessary strain.

The problem of supporting the table of a shaper is not quite the same as supporting the knee of a milling machine, because in the latter case the knee has no lateral movement. The shaper table has a lateral feed, and any support must allow for this movement. In some designs a machined base is furnished on which the support can run, while in others a narrow facing serves this purpose. There is much variety in the arrangements, the sliding action taking place on the base, on a ledge higher up, or on the underside of the table. If rigidity of construction is assured in any type of support, the next important thing is freedom from chips. In some designs where this vital point is neglected, the table is sprung upward by the supporting device riding on chips or grit. A further consideration in designing a support is whether it shall sustain only the downward thrust and the bending tendency, or whether it shall also take care of lateral and upward deflection due to cutting in those directions. Some supports are arranged to meet these conditions.

Simple Forms of Support

A round bar is used as a support on machines built by the Cincinnati Shaper Co., a bracket being attached to the table, as shown in Fig. 1. The bar is gripped in this bracket by tightening a screw after the bar has been brought down to rest on the machined surface of the base. In order to provide a larger sliding surface on the supporting member, some designers prefer a foot, as shown in Fig. 2, which also serves effectively to prevent tilting. The support in Fig. 1 is also often provided with a foot. That in Fig. 2 is found on shapers made by Greenwood & Barley, Ltd., Leeds.

The usual practice of holding the supporting bar by friction alone is modified in shapers built by the American Tool Works Co., by having a series of notches and a locking plunger that afford a positive check to slipping. This construction is shown in Fig. 3. Near the bottom of the table a spring plunger *A* engages one of the notches along the bar, and the bar is then held firmly by means of bolt *B* which has a machined surface at the end that engages the bar. Any slight adjustment that may be necessary is made by turning the split nut *C*, which is locked in place by tightening screw *D*. The Smith & Mills Co. also utilizes a bar support, but instead of travelling on the base, it always remains in a central position under the tool, the underside of the table sliding on the cap of the support. The arrangement is shown in Fig. 5. The machine base is recessed at the front, and a bracket is mounted on machined sur-

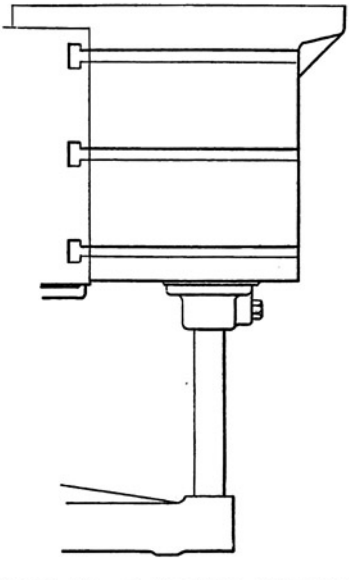


Fig. 1. Simple Designs of Round-bar Supports for Shaper Tables, provided to eliminate Deflection caused by Overhang of the Table

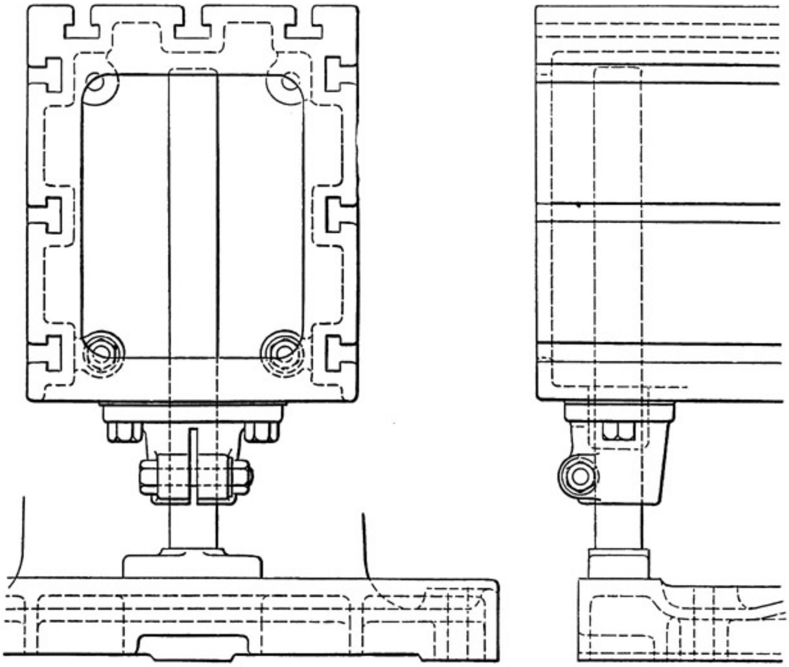


Fig. 2. Simple Designs of Round-bar Supports for Shaper Tables, provided to eliminate Deflection caused by Overhang of the Table

faces on each side. A sleeve set into a bearing at the top of the bracket permits vertical adjustments of the bar. This sleeve may be clamped in any required position.

Designs in which Brackets are Employed

In many instances a bracket of rectangular cross section is substituted for the bar support, the bracket construction being used to resist twisting stresses on the table. Sometimes this design is adopted in order to obtain an increased area of the wearing surfaces. Methods of jointing the bracket and table together vary. Some bracket supports are bolted directly to an ordinary table without any special provision for the purpose, while in other cases slots, surfaces, or apertures are machined for the support. Fig. 6 illustrates a plain two-slot bracket bolted to the front of the table on a large traversing-head machine built by Henry Holmes & Co., Halifax. This bracket has two feet. A similar example, but with a V-shaped foot having felt pads and sliding on a V-strip on the base is shown in Fig. 4. This design is found on shapers made by the John Bertram & Sons Co., Dundas, Ontario, Canada. The arrangement shown in Fig. 7, which transfers the clamping position from the front to the underside of the table, is a feature of the machines made by the Ormerods Tool Co., Ltd., Hebden Bridge. The angle bracket materially stiffens the slotted upright.

Giving the upright an inside location offers a slight advantage by leaving the front of the table practically clear. The Oldfield & Schofield Co., Ltd., Halifax, follows this method. From Fig. 8 it will be observed that the support extends through the bottom of the table and is clamped, by means of a T-slot and bolt, to an angle bracket attached to the table.

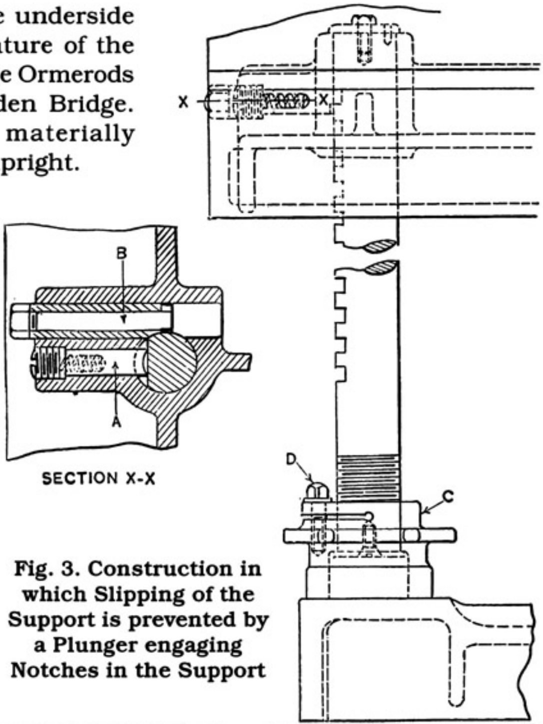


Fig. 3. Construction in which Slipping of the Support is prevented by a Plunger engaging Notches in the Support

On Gould & Eberhardt shapers a lug is cast on the underside of the table, as shown in Fig. 10. A finished surface on this lug affords a seat for the support, but instead of the latter being situated near the front of the table, a midway location is selected, so that the support will

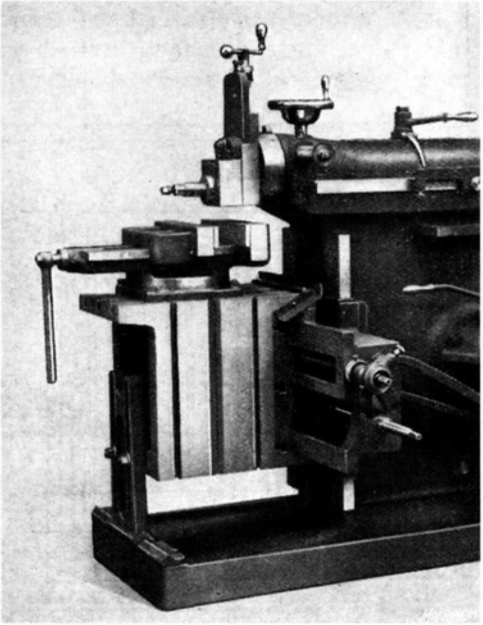
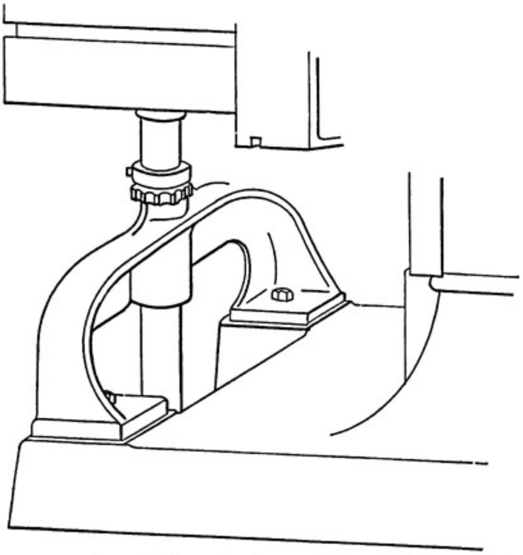


Fig. 4. Bracket Support in which the Lower End slides on a V-shaped Strip attached to the Machine Base

Fig. 5. Example in which the Supporting Bar extends through a Sleeve in a Bracket mounted on the Base of the Machine



sustain much of the weight ordinarily placed on the cross rail. The slotted upright has a series of serrations on each side of the opening, and is fastened to the table lug by means of a stud bolt and a member which engages the serrations. Final adjustment for height is effected by set screw *A*. The machine base projects well forward and has T-slots for holding certain classes of work.

The tables of Hendey shapers are also supported at about the centre through the use of an angle bracket and a double-slotted upright, but instead of sliding the foot of the upright upon an exposed surface, a special channel-shaped guide is provided, as shown in the heading illustration. The top lip of this guide acts as a guard against dirt and chips. The table in this view has an extension dowelled and bolted to the front end to accommodate long work.

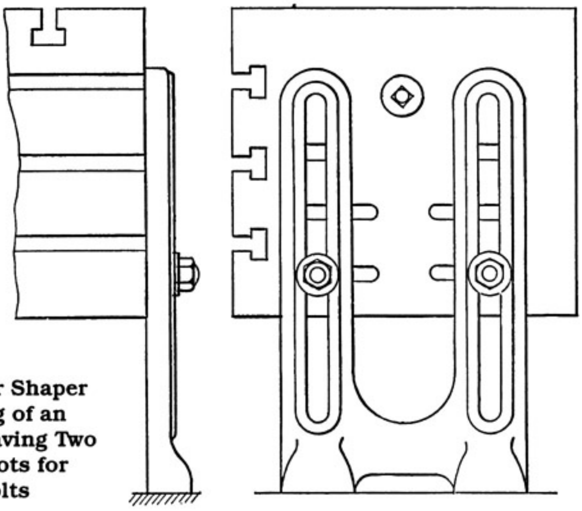


Fig. 6. Support for Shaper Table consisting of an Upright Bracket having Two Feet and Two Slots for Clamping Bolts

Sliding Surfaces at Other Locations than at the Base

The sliding face on the base is avoided in several designs by

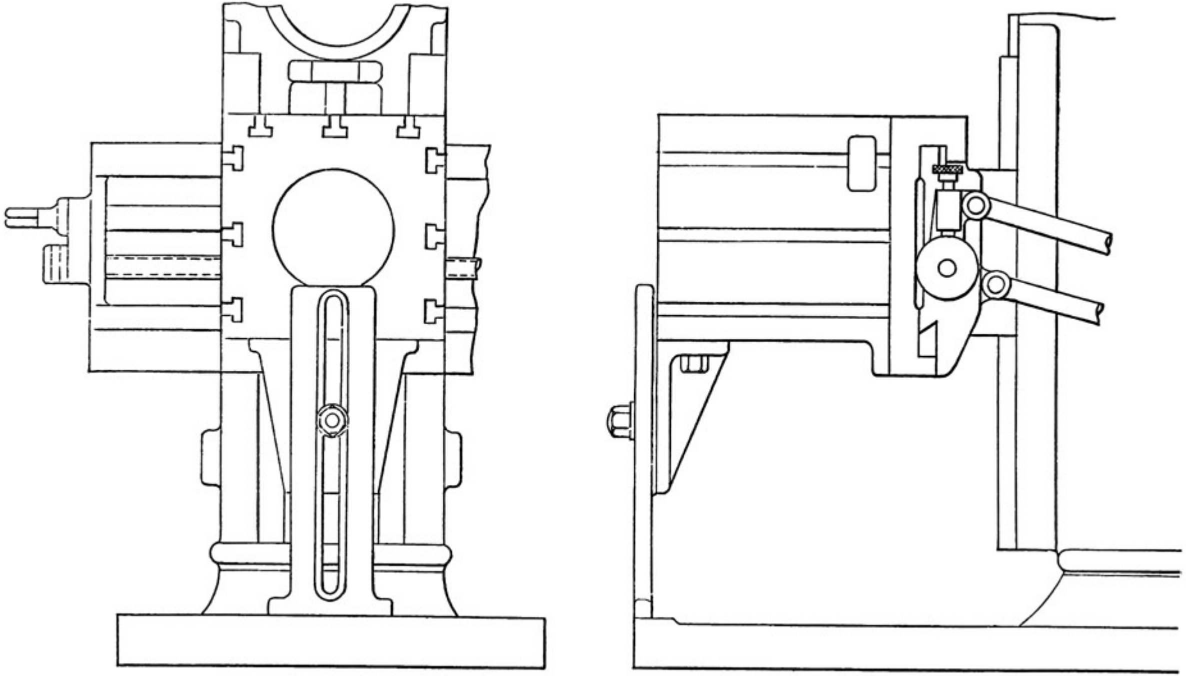


Fig. 7. Design in which the Upright is attached to an Angle Bracket fastened to the Underside of the Shaper Table

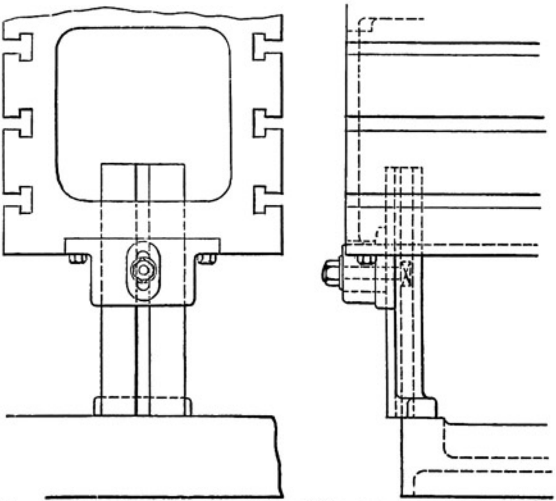


Fig. 8. Support extending into the Table so as to leave the Front Free from Obstruction

having an inverted strip slide on a bracket attached to a fixed support bolted to the machine base. One such arrangement is illustrated in Fig. 11, the short angle bracket *A* supporting the longer one *B* which is bolted to the table. In order to prevent the lifting or twisting of the table, the addition of a strip to resist such deflection is occasionally found advisable. The Streine Tool & Mfg. Co. employ the design illustrated in Fig. 9, which consists of the upright *A*, bearing strip *B*, and slide *C*. On the Queen City shapers a similar result is obtained by having a finished projecting lip at the bottom corner of the table, as shown in Fig. 12, and gibbing the slide casting to it. This prevents lateral or upward displacements and guards against chips.

Fig. 13 shows a radical difference in the location of the bearing surfaces, the adjustable section of the support reaching right up under the overhanging lip at the top of the table and being gibbed with a strip the full width of the table. This design is found on the larger sizes of machines constructed by the Davis Machine Tool Co. The smaller

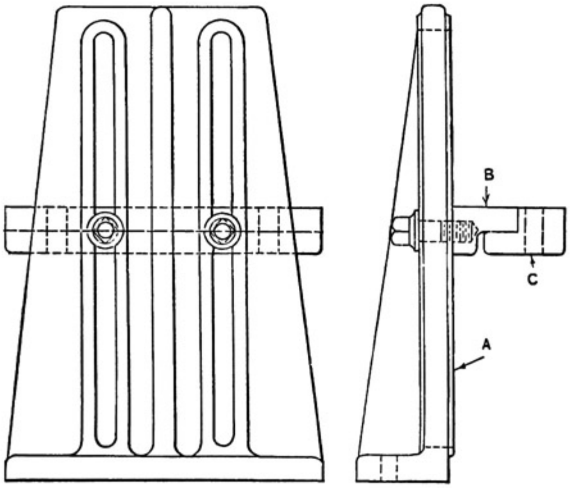


Fig. 9. Details of a Design which prevents both Lifting and Twisting of a Shaper Table

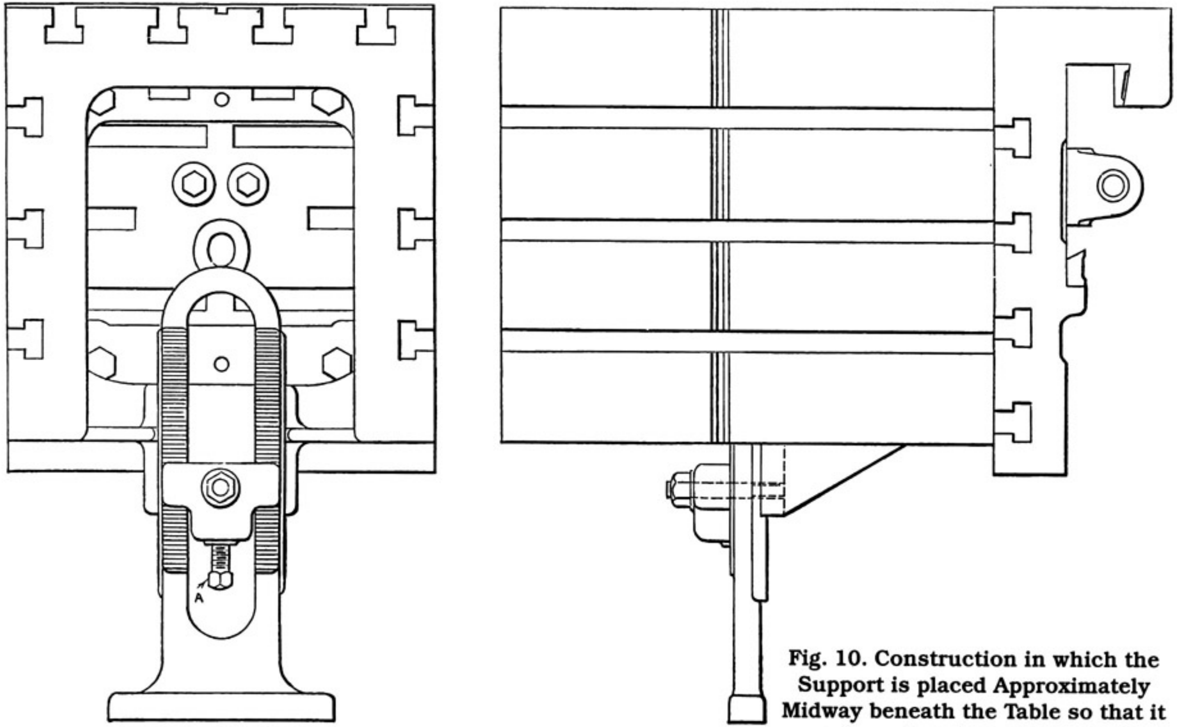


Fig. 10. Construction in which the Support is placed Approximately Midway beneath the Table so that it sustains a Considerable Part of the Weight ordinarly borned by the Cross Rail

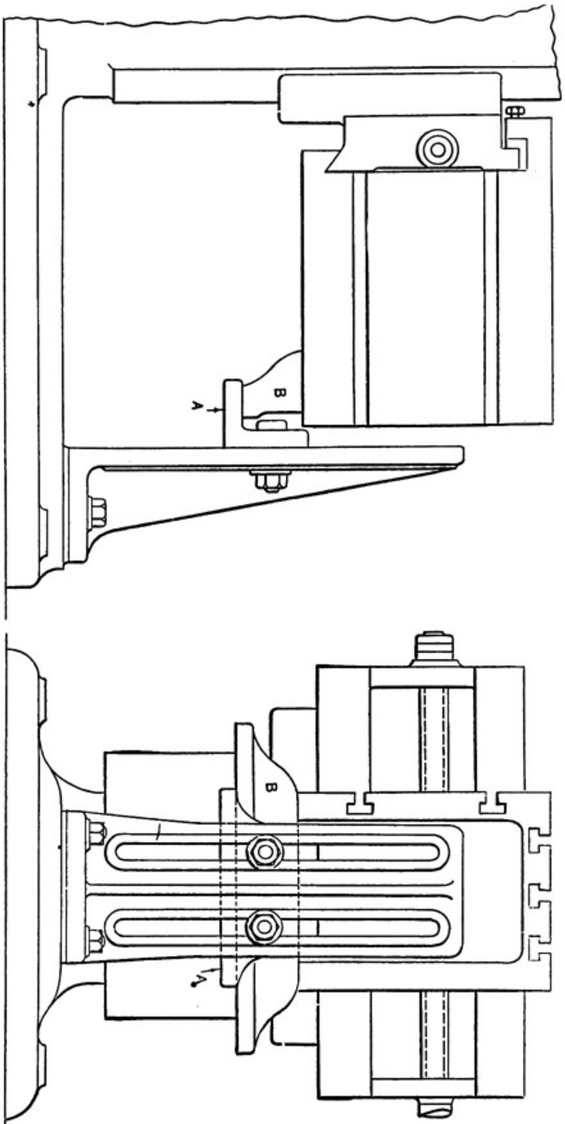


Fig. 11. An Example in which the Sliding Surface of the Support is brought close to the Underside of the Table

machines have the angular support, illustrated in Fig. 15, which is bolted by means of two spreading feet to the cross rail, and held rigid by a central foot which is supported on a vertical face on the column.

Supports provided with Rollers

Rolling contact is utilized only to a limited extent for the

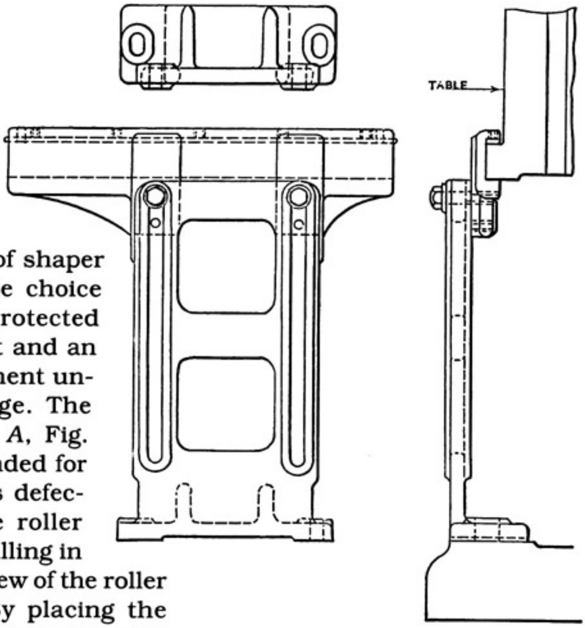


Fig. 12. Support having a Casting at the Upper End that is gibbed to a Machined Lip on the Table

moving surfaces of shaper supports, and the choice varies between protected rollers on the foot and an inverted arrangement under the table edge. The simple design at *A*, Fig. 16, which is intended for a small shaper, is defective, because the roller rides over chips falling in its path. An end view of the roller is shown at *C*. By placing the roller under the table edge, the trouble from chips may be avoided. Several firms adopt this latter construction, including the Whipp Machine Tool Co., and the Steel Products Engineering Co. Such a design is shown at *B*, in which a well-ribbed bracket is bolted to the base, this bracket having a vertical slot through which passes the clamping bolt of the roller bracket. Some of the draw-cut shapers have a

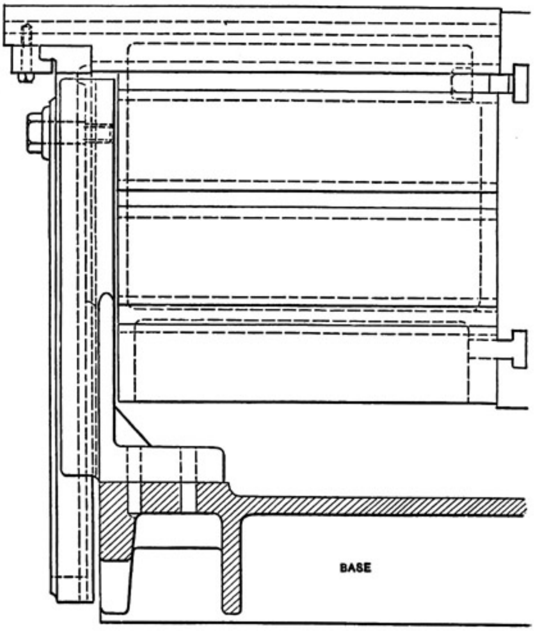


Fig. 13. Table supported by Means of an Overhanging Ledge at the Top near the Front End

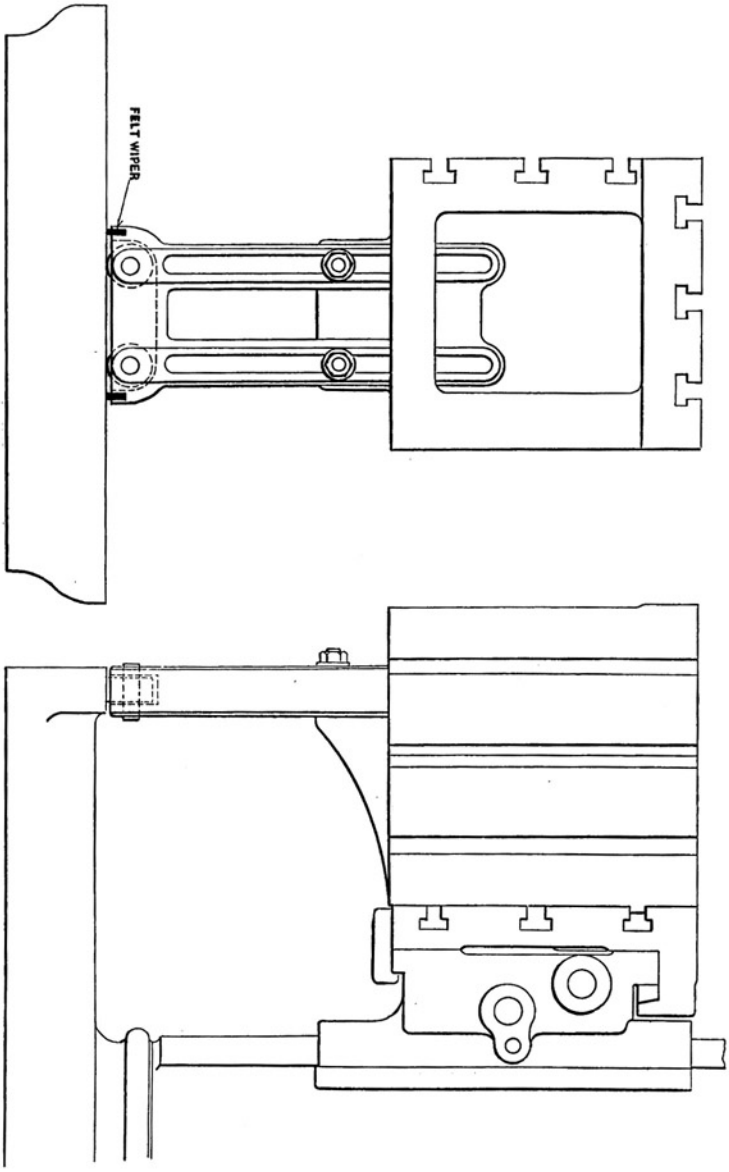


Fig. 14. A Double-roller Support in which Felt Wipers are provided at each End to keep the Path of the Rollers free from Dirt and Chips

roller-bearing support travelling on a machined surface on the base, but protection is ensured by felt wipers. This is also the case with the design shown in Fig. 14, in which the use of two rollers provides a good broad base. This type of support is

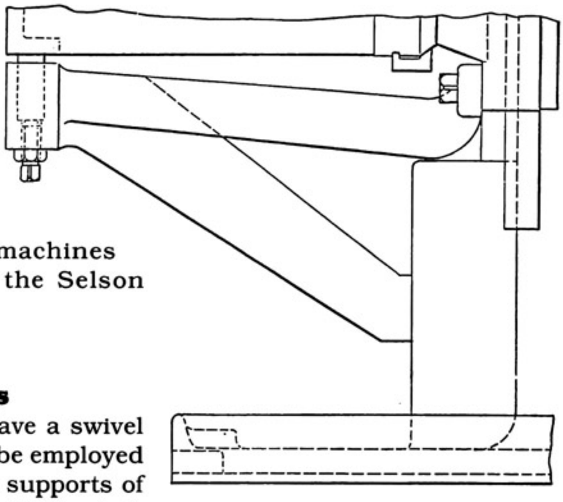


Fig. 15. Table Support having Two Spreading Feet Bolted to the Cross Rail and a Central foot that carries the load.

employed on the machines manufactured by the Selson Engineering Co.

Supports for Swivelling Tables

Tables which have a swivel adjustment cannot be employed in conjunction with supports of the types hitherto illustrated, some extra provision being necessary to allow for swivelling. If the table revolves on a pivot extending to the front of the table, the support may be clamped to this pivot, but if there is no such pivot, the upper part of the steady bracket must be made with circular slots to correspond with similar T-slots on the table front. Two or three bolts in these circular slots would enable adjustments to be made. The shapers made by the R.A. Kelly Co. are equipped as shown in Fig. 17. The plate *B* enables the table to be rotated 40 degrees each side of the vertical, the plate having a bearing edge that slides upon clamp *C*. The latter is secured at a suitable height on upright *A*. Plate *B* consequently remains level at all times, while the table can be swivelled after the bolts in the curved slots

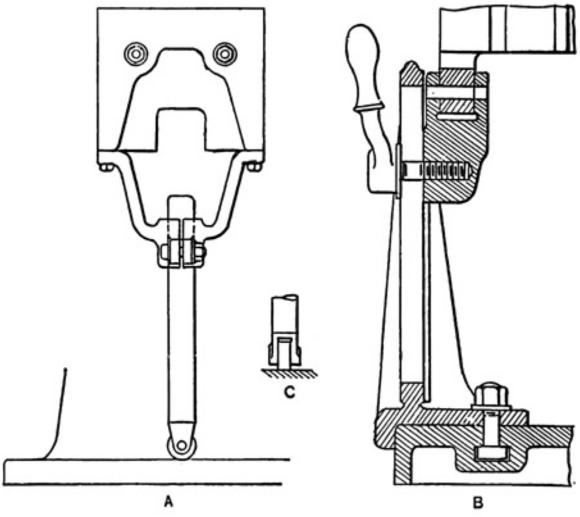


Fig. 16. Two Designs of Table Supports in which Rollers are employed instead of Sliding Members

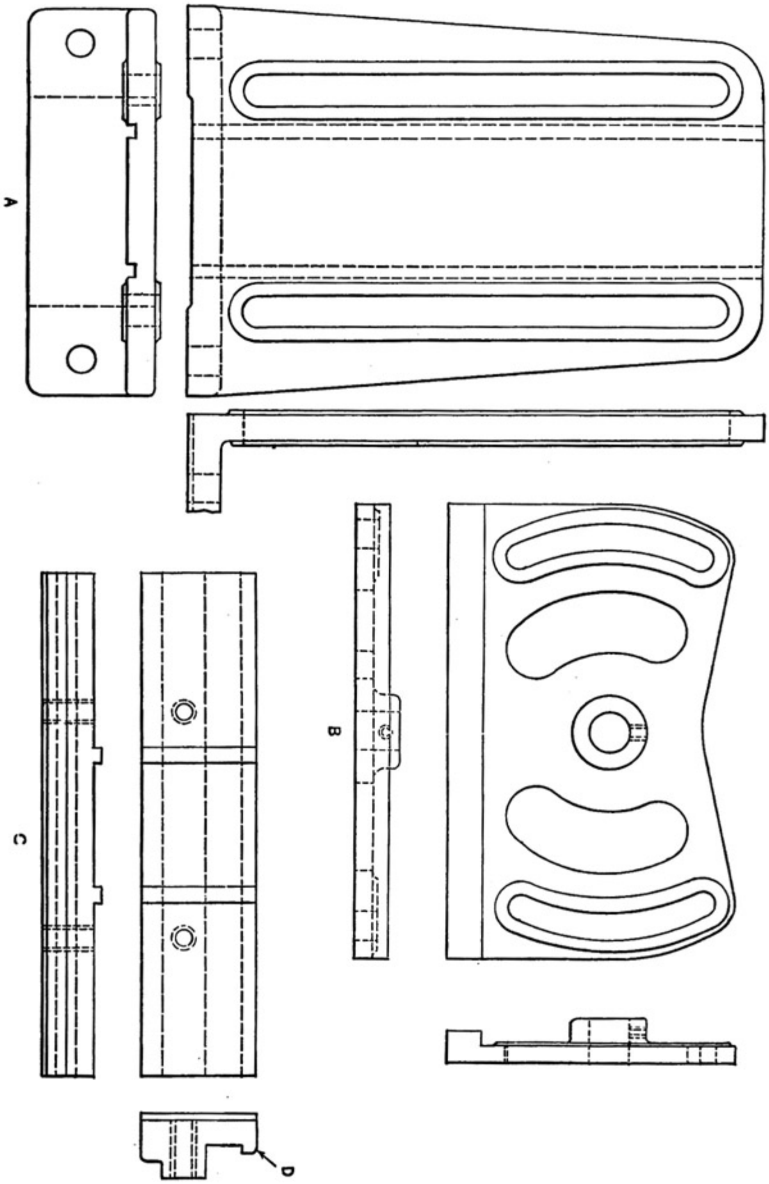


Fig. 17. Details of a Support of a Table which must be swivelled about a Horizontal Axis

have been loosened. There are slots cut on the back of the upright which guide the tongues of the clamping strip; the latter has a ledge at *D* that prevents dirt and chips from falling on the sliding faces.

Excerpts from

Planer and Shaper Attachments

Special Equipments that adapt Planers and Shapers for performing Unusual Operations

MACHINERY – MARCH 15, 1923

Grinding Attachments for the Planer and Shaper

It is sometimes desirable to equip a planer or a shaper for performing surface grinding operations. Examples of machines so equipped are shown in Figs. 5 and 8. These illustrations make the arrangement and use of both of these attachments quite clear without requiring detailed descriptions, but it may be mentioned that the open-side planer shown in Fig. 5, was furnished with a motor-driven grinding head on the rail for grinding railroad crossings to a smooth finish after planing. Similarly, a small electric grinding head is secured to the clapper of the shaper shown in Fig. 8 to adapt this machine for performing surface grinding operations on small and medium-sized pieces of work. Both of these attachments are in the nature of makeshifts, and are not intended for performing grinding operations on regular production work.

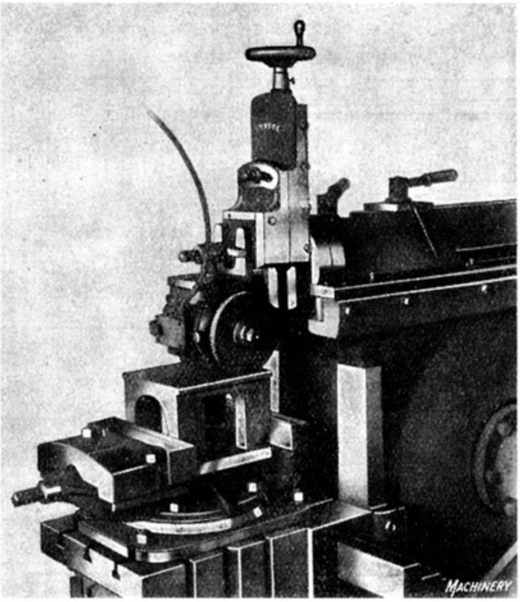
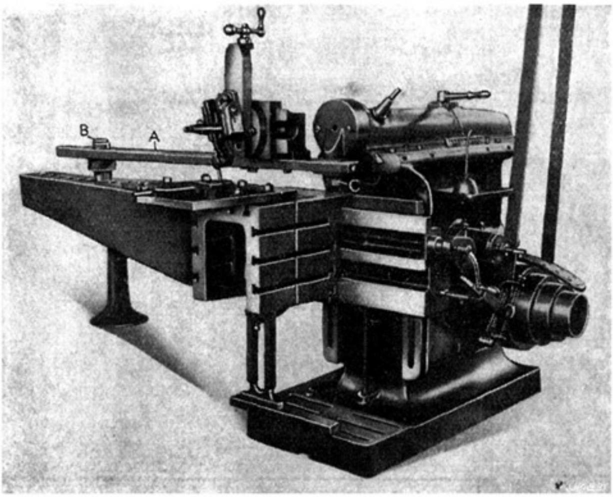


Fig. 8. Shaper furnished with Portable Grinding Machine in the Toolpost for performing Surface Grinding Operations on Small Work

Radius Planing Attachment for a Shaper

Fig. 10 illustrates a traversing head shaper, which is equipped for performing a radius planing operation. This is accomplished by removing the short rail that carries the tool-head from the shaper ram, and bolting it to a radius arm *A*. At the left-hand end of this radius arm a number of holes are drilled so that the attachment can be set

Fig. 10. Radius Planing Attachment for the Shaper



up in such a manner that the distance from the pivot *B* to the cutting point of the shaper tool, is equal to the radius of curvature which it is required to plane in the work. At the right-hand end, the radius arm is secured to the ram by means of a pivot *C*. Bearing in mind that the tool-head is carried on the radius arm, it will be evident that as the ram reciprocates to and fro, the point of the tool will generate a surface with a radius of curvature equal to the distance from the pivot *B* to the tool-point. This distance can be adjusted by putting pivot *B* into different holes in the left-hand end of arm *A*. Obviously, the pivot *C* must be held in a lengthwise slot in arm *A*, to allow for the change of distance between pivots *B* and *C* while the shaper ram is reciprocating.

Attachment for cutting Oil Grooves on the Shaper

When it is required to cut straight oil grooves in bushings, without having them run out at either end, such work can be performed rapidly on a shaper equipped as in Fig. 12. The bushing A in which the oil groove is to be cut, may be

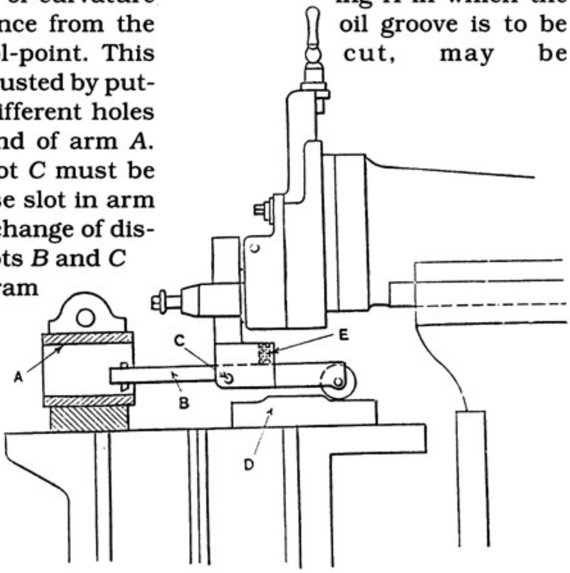


Fig 12. Tool Equipment for shaping Oil Grooves in Bushings

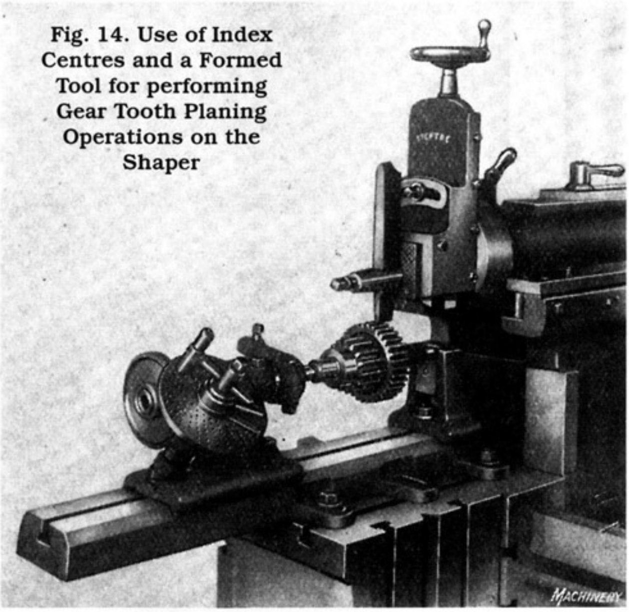


Fig. 14. Use of Index Centres and a Formed Tool for performing Gear Tooth Planing Operations on the Shaper

clamped to the table in any convenient manner. Secured to the shaper toolpost there is a holder, at the lower end of which a pivoted bar *B* is carried. At an equal distance in either direction from pivot *C* are held a cutter bit and a cam roller that runs in contact with master cam *D*. The rise on this cam is of the same form as the oil groove which is to be cut in the work, the oil groove being depressed an amount corresponding to the rise on the cam. As the shaper ram reciprocates, the cam roller runs up over the rise on master cam *D* and the cutter bit is correspondingly depressed. A compression spring *E* maintains uniform contact between the cam and the roller, thus assuring the planing of the oil groove to the required form. The tool may be fed to depth either by hand or automatically.

Application of Index Centres on the Shaper

A jobbing shop is often called upon to execute orders for repair work on gears, and an occasional operation of this kind can be handled on a shaper furnished with a set of index centres. Fig. 14 (page 742) illustrates a machine furnished with index centres.

In out-of-the-way shops a shaper is often used for repair work, instead of buying an expensive gear-cutting machine, for which there would be little regular work. The method of procedure is to form a piece of steel to approximately the shape of the tooth, insert it in the gear, and then plane this insert to the required tooth form with the shaper tool. Obviously the shaper tool must be finished to exactly the same shape as the space between two teeth of the gear on which the repair is being made.

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